A

Detailed Project Report

to the

Department of the Army
New England Division, Corps of Engineers
Waltham, Massachusetts

on a

Water Resources Improvement Study
for the
Island End River
Chelsea, Massachusetts

Contract No. DACW 33-C-79-0076

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LOCATION PLAN

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DETAILED PROJECT REPORT

INTRODUCTION

This report is a detailed engineering and economic feasibility study of channel improvements for small recreational craft at the Island End River, Chelsea, Massachusetts. The Island End River is a tidal estuary approximately 3500 feet in length and averaging 500 feet in width. It forms a portion of the boundary between the cities of Everett and Chelsea. As indicated in Figure 1, the Project Area is located two miles north of downtown Boston. The proposed channel improvements would extend from the river's mouth to a proposed marina which is to be located approximately 500 feet upstream on the former Chelsea Naval Hospital site.

The Chelsea Naval Hospital served as a U. S. Navy installation since the early 1800's. In 1974, the property was declared surplus and was turned over to the General Services Administration for disposition. Since then, a redevelopment master plan has been prepared for the site and the City of Chelsea has taken steps to acquire portions of the property. The development of a marina and related facilities are key aspects of the redevelopment master plan.

If these plans are to be fully realized, improvements to the navigation channel in the Island End River are necessary. Previous studies by the New England Division of the U. S. Army Corps of Engineers set forth the preliminary findings and established the need for a more detailed study of channel improvement options. This report summarizes the detailed analyses of the feasible channel improvement alternatives.

In a letter dated Devember 11, 1978, the City of Chelsea concurred with the findings of the Reconnaissance Report and recommended that the Detailed Project Report be undertaken. The City of Everett concurred with this recommendation in a letter dated December 15, 1978.

During the course of this study, ten preliminary alternative plans setting forth various channel alignments and marina concepts were developed and evaluated. Four plans were selected for more detailed study. Plan B, which provides the maximum net benefits, has been designated as the tentatively selected plan. It involves construction of a 100 foot wide, six foot deep navigation channel in the Island End River. This channel would extend 2500 feet upstream from the Mystic River.

STUDY AUTHORITY

This study was initiated by the New England Division of the U. S. Army Corps of Engineers at the request of City of Chelsea officials. It was prepared under the provisions of Section 107 of the 1960 Rivers and Harbors Act, P.L. 86-645, as amended.

SCOPE OF THE STUDY

The scope of this study includes performance of a Comprehensive Water Resources Improvement Study and preparation of a Detailed Project Report consisting of:

1. Determining the navigational needs of the study area.

2. Developing alternative channel improvement plans.

3. Evaluating the economic, social and environmental impacts of the alternative plans.

4. Recommending channel improvements that are economically feasible, socially beneficial and environmentally acceptable.

Although this study is primarily oriented towards small craft, the needs of commercial shipping in the existing deep water channel were also considered.

The geographical scope of this study is generally limited to the Island End River upstream from its confluence with the Mystic River. In those instances where project impacts extend beyond the study area, these impacts are evaluated in general terms.

STUDY PARTICIPANTS

Consultations with federal, state and local government agencies formed an integral component of the study process.

At the federal level, coordination involved the U. S. Environmental Protection Agency, the U. S. Fish and Wildlife Service, the U. S. Coast Guard and the National Marine Fisheries Service.

At the state government level, major participants included the Office of Coastal Zone Management, the Division of Marine Fisheries, the Department of Environmental Quality Engineering and the Metropolitan District Commission.

The City of Chelsea was consulted throughout the course of the study. Those involved included the Mayor's office, the City Engineer, the Community Development Director and the City's consultant for the Chelsea Naval Hospital Redevelopment Project.

Appendix 3 contains a complete list of the government agencies consulted during the course of the study and a summary of their views and comments on the improvement plans.

STUDIES OF OTHERS

The impetus for the current project resulted from the decommissioning of the Chelsea Naval Hospital in 1974. When the property was declared surplus, several studies were undertaken to evaluate its conversion to civilian use.

A 1974 study by Justin Gray & Associates, entitled A Recommended Plan for the Reuse of the Naval Hospital - Chelsea, Massachusetts, proposed construction of a marina on the Island End River.

Development of a marina and dredging of a navigable channel were evaluated further in the Development Master Plan and Feasibility Analysis - Chelsea Naval Hospital by Anderson Nichols, Inc., et al. In addition to housing and a waterfront park, it proposed that a portion of the Naval Hospital property be used for industrial and commercial development. A marina serving 250 boats and a site for related marine enterprises were the primary focus of the industrial/commercial redevelopment area.

The 1978 Reconnaissance Report by the Corps of Engineers was the first study to focus upon the proposed channel improvements.

THE REPORT AND THE STUDY PROCESS

The initial steps in the study process included a comprehensive inventory of available information, performance of topographic and hydrographic surveys, and preparation of base plans. As indicated under Public Views, extensive efforts were expended to contact public officials and interested parties to provide information and to seek public input into the study process. Based upon available information, baseline conditions were determined to formulate planning objectives and constraints. Preliminary improvement plans were developed and evaluated. These were presented to local public officials and interested groups at a meeting on August 9, 1979. Based on comments received, four alternative plans were selected for more detailed study.

This Detailed Project Report consists of a Main Report and supporting appendices. The body of the Main Report is structured in accordance with the planning process followed during the course of the study. It is organized as follows: Problem Identification, Formulation of Preliminary Plans, Assessment and Evaluation of Detailed Plans, and Comparison of Detailed Plans.

The report has seven appendices: Appendix 1, Problem Identification, supplements the material in the first two sections of this report. Appendix 2 addresses the formulation, assessment and evaluation of alternative plans. Appendix 3 summarizes public views and responses. Appendix 4 contains supporting engineering data and analyses. Appendix 5 reviews natural, social and cultural resources. Appendix 6 contains background information on benefit/cost studies. Appendix 7 evaluates the feasibility of alternative plans for disposal of dredged material. Appendix 8 contains the project environmental assessment.

PROBLEM IDENTIFICATION

This portion of the report sets forth the nature and scope of the problems necessitating channel improvements, and establishes the planning objectives and constraints which give direction to subsequent planning tasks.

NATIONAL OBJECTIVES

Planning for channel improvements in the Island End River is based in part on the national objectives of National Economic Development (NED) and enhancement of Environmental Quality (EQ) as set forth in 1973 by the National Water Resources Council in _Principles_ and Standards for Planning _Water and_ _Related Land Resources_. The purpose of the Principles and _Standards_ is to promote the quality of life by planning for the attainment of the following objectives:

NED Objectives -

To enhance national economic development by increasing the value of the nation's output of goods and services and by improving national economic efficiency.

EQ Objectives -

To enhance the quality of the environment by the management, conservation, preservation, creation, restoration or improvement of certain natural resources, cultural resources and ecological systems.

EXISTING CONDITIONS

LOCATION

The Island End River is located approximately two miles north of downtown Boston in the heart of the Boston Metropolitan area. The river forms a portion of the boundary between the Cities of Chelsea and Everett, and coincidentally Middlesex and Suffolk counties. The Island End River flows into the Mystic River about one-half mile upstream of the confluence of the Mystic and Chelsea Rivers, in Boston's Inner Harbor.

SOCIAL AND ECONOMIC CHARACTERISTICS OF THE STUDY AREA

Everett and Chelsea are small cities typical of older urban areas surrounding the City of Boston. While the population of the Boston Metropolitan area has increased in recent years, the populations of Everett and Chelsea have declined.

Median educational levels are lower in Chelsea and Everett than the average for the metropolitan area.

While the majority of workers in Chelsea and Everett are classified as white collar, the percentage of white collar workers is lower than the regional average. The percent of workers in the blue collar occupations, such as craftsmen, operatives and laborers, is forty-one percent in Chelsea, as compared to twenty-eight percent for the Boston Metropolitan area.

The major industries in Chelsea and Everett are diverse and include the manufacturing of metals, electrical machinery, stone, clay glass, paper, rubber and plastics, as well as the wholesaling and distribution of fruit and vegetable produce. These cities also serve as major storage and distribution centers for various petroleum products and natural gas.

In both Everett and Chelsea, land use is characterized by residential areas in the central and northern parts of these cities with industrial development to the south and along the waterfronts.

With the exception of the Chelsea Naval Hospital grounds, most of the waterfront along the Chelsea, Mystic, Island End and Malden Rivers is devoted to industrial uses. Thus, the waterfront is generally inaccessible for recreational purposes. Land use along the shoreline of the Island End River is characterized by the intensively developed industrial area on the Everett side and by the relatively underdeveloped grounds of the former Naval Hospital on the Chelsea side. This underdeveloped land provides an opportunity for a much needed waterfront recreation area.

On the western shoreline at the mouth of the Island End River, an Exxon Corporation terminal fronts on both the Mystic River and Island End River. Berths for oil tankers are located along the Mystic River while berths for smaller barges extend about 350 feet north along the Island End River waterfront. Petroleum products including gasoline, fuel oil, and asphalt are transferred by pipeline to and from bulk storage facilities nearby.

North of the Exxon Corporation terminal are the Marquette Cement Company and the Coldwater Seafood Corporation. These companies maintain berthing facilities on the Island End River that are used on a regular basis by barges and freighters.

North of the Coldwater Seafood Corporation abandoned wharves extend an additional 600 feet along the shoreline where land uses abutting the river consist of small industries that are not served by shipping. At the northern end of the river on the Everett shoreline, the river borders a parking lot behind a produce warehouse. A rail spur is situated on an easement along the wharves near the shore.

North of the river, land uses consist primarily of industrial buildings and warehouses. A bank and a large Polaroid manufacturing plant are located immediately adjacent to the northern end of the river.

The easterly shore of the Island End River borders the Chelsea Naval Hospital site. This site, which is under the jurisdiction of the General Services Administration, contains sixty-eight vacant structures, including the main hospital building, living quarters and supporting facilities.

NATURAL RESOURCES AND ENVIRONMENTAL SETTING

At one time the Island End River drained an extensive salt marsh which occupied presently developed areas of Everett and Chelsea. The river formerly followed a course which curved to the west from its present terminus and then in a semicircle back to the east to a location on the Naval Hospital site. Over the years, the marsh was filled to provide land for urban development, reducing the river to its present size. Most of the reclaimed land to the northwest of the river is relatively flat and lies at an elevation of fifteen to twenty feet above MLW.

To the east of the Island End River, the Naval Hospital site, occupies a glacial drumlin rising about one hundred twenty feet above MLW.

Subsurface conditions in the Island End River are variable east to west. Glacial till is found closer to the surface on the easterly side of the river.

The climate of the project site is affected by its proximity to the Atlantic Ocean. Average temperatures range from a low of twenty-eight degrees Farenheit in January to a high of seventy-one degrees Farenheit in July. The prevailing wind direction is northwest in winter months and southwest in summer months. Occasionally, hurricanes and other severe storms effect the site.

Mean tidal range in the Island End River is 9.5 feet with a spring range of approximately 11.0 feet. Storm water levels of up to three feet above mean high water (MHW) are likely to occur during storms.

Low tides of 2.0 feet below MLW occur regularly with the average yearly lowest tide of 3.0 below MLW.

Currents in the Island End River and the Mystic River are relatively gentle, attaining a maximum velocity of about 1.5 knots.

Due to short fetch length, wind driven wave heights are generally limited to less than two feet on the Mystic River and substantially less on the more sheltered Island End River. The most common wave action results from the wakes of passing vessels.

The Island End River is a tidal estuary approximately 3,000 feet long and about 400-500 feet wide at MHW, but narrowing to about 100 feet at the northern end of the river where two large corrugated steel arch culverts outfall.

A twenty-four foot deep (at MLW) channel varying from 100-250 feet in width extends from the Mystic River along the Everett shoreline for a distance of 1400 feet. It accommodates the barges and freighters serving the industries on the Everett shoreline.

To the east and north of the channel, the river bottom forms an exposed mud flat at low tide. To the north, the mud flat averages 400 feet in width and is divided by a meandering stream about twenty to thirty feet in width and two feet deep at MLW. To the east of the channel, the bottom rises gently for about two hundred feet across the river to a steep bank on the Chelsea shoreline.

South of the Coldwater Seafood facility, the shoreline of the river generally consists of wharves and bulkheads adjacent to the industrial enterprises. North of Coldwater Seafood the shoreline consists of deteriorated cargo wharves, timber retaining walls and banks of fill composed of rocks and rubble such as broken concrete and bricks.

The largely underdeveloped eastern shoreline borders the Naval Hospital site. It generally consists of a steep bank extending from a mud flat up to a level grassy area at an elevation of fifteen to twenty feet above MLW. This bank is retained by a seawall along the first several hundred feet of the shoreline near the river mouth. North of the seawall the unprotected steep bank extends for a distance of 500 feet. It is eroding and localized areas are being undercut between the high water line and the top of the bank.

Upstream from the steep bank there is a one hundred foot wide salt marsh at an elevation just above high water level.

Because the Island End River is polluted, the species found there tend to be pollution tolerant. Near its mouth at the Mystic River, where tidal flows provide a cleansing effect, a greater diversity of species is found.

Clamworms, which are pollution tolerant, were found in the intertidal zone throughout the river; however, they were found in higher concentrations in the upper part of the river. In the intertidal zone toward the mouth of the river, less pollution tolerant organsims, such as softshell clams, blue mussels and barnicles were found.

PRESENT NAVIGATION

Three industrial firms now use the Island End River. The Exxon Corporation presently berths one hundred fifty vessels per year on the Island End River. The largest of these vessels is a barge with a capacity of 100,000 barrels and a draft of twenty-two feet. Exxon Corporation officials anticipate that barges having capacities of up to 150,000 barrels with drafts of thirty feet could be used in the future.

The Marquette Cement Corporation presently uses a barge approximately three hundred feet in length with a twenty-two foot draft. Marquette receives two or three shipments per month.

Coldwater Seafood Corporation has an average of one refrigerated freighter docking per week. The largest ship is about 370 feet in length with a draft of twenty-two feet.

Due to the narrowness of the existing channel, all of the ships using the Island End River are assisted by tugs.

At the present time, recreational boating on the Island End River is minimal.

CULTURAL RESOURCES

The Chelsea Naval Hospital property constitutes a significant cultural resource as signified by its nomination to the National Register of Historic Places.

The original main hospital building was completed in 1835 at the base of the hill facing the Mystic River. In 1836, land was turned over to the Bureau of Ordinance and two buildings were constructed as powder magazines on the western side of the property near the Island End River. Behind these two buildings, a pier was constructed in the Island End River. It is believed that the U.S.S. Constitution was among the ships that were stocked from these magazines; hence, they have come to be called the Constitution Magazine.

GOVERNMENT AGENCY PLANS AND PROGRAMS

The proposed navigation improvements to the Island End River are one aspect of a comprehensive plan for redevelopment of the Chelsea Naval Hospital property.

The Master Plan for redevelopment of the hospital property estimates that $13 million of public funds will be committed along with $67 million of private investment. The City of Chelsea has applied to the Economic Development Administration of the U.S. Department of Commerce and to the U.S. Department of Housing and Urban Development for major funding grants. Using the funding provided by EDA and HUD grants, the City plans to acquire land, demolish buildings and improve roadways and utilities.

Construction of a twenty-six acre park along shores of the Mystic and Island End Rivers will be undertaken by the Metropolitan District Commission.

At the proposed marina site, the City plans to dredge the marina basin, make some repairs to buildings and provide the required bulkheads, rip-rap, piers, and floats. Private developers will be responsible for site grading, landscaping and restoration of the Constitution Magazine buildings. These buildings will be renovated for use by marina-related enterprises in accordance with historic architectural guidelines. The City will transfer the marina to the developer on a long term lease providing that berthing space be made available on an equitable basis.

A boat launching ramp and marine service facility will be available to the general public.

CONDITIONS IF NO FEDERAL ACTION IS TAKEN

Without the proposed project, development of a small boat marina on the Naval Hospital grounds is not likely. The cost of dredging a marina basin and an access channel without federal assistance would probably be economically prohibitive to the City of Chelsea.

Plans for redevelopment of the Chelsea Naval Hospital would be adversely affected if improvements to the Island End River are not implemented. These plans call for a substantial townhouse development oriented toward the marina. Without the improvements to the Island End River and the construction of the marina with its related facilities, the marketability of the housing would be adversely affected. The Constitution Magazine building would probably not be restored since there would be limited incentive for private investment.

Development of the MDC park will occur as planned if the federal improvements to the river do not take place. However, the potentially synergistic effects arising from the proximity of public open space and recreational boating would not occur.

Without the proposed project, conditions in the Island End River can be expected to remain essentially as they are today. It is possible that the commercial channel on the Everett side may be widened or deepened. It is unlikely that it will be extended further north as the industries already established upstream of Coldwater Seafood Corporation have no need for water access.

Water quality in the river can be expected to improve gradually in the future as measures to clean up the Mystic River and Boston Harbor are implemented. Species such as clams and mussels might slowly re-establish themselves in upstream portions of the Island End River, although the river would remain closed for shellfishing for the foreseeable future.

Without the proposed channel improvements a limited amount of recreational boating might be expected in the future. The boats could be moored offshore and allowed to ground at low tides. Use of the boats would obviously be restricted by tidal fluctuation.

PROBLEMS, NEEDS AND OPPORTUNITIES

Identifed through consultation with government agencies and local businesses, were a number of concerns and issues which had to be addressed during the course of this study. The following is a summary of the issues raised:

THE PROBLEM OF A LIMITED TAX BASE AND EMPLOYMENT OPPORTUNITIES

The City of Chelsea is relatively poor and geographically small. The tax base still suffers from the effects of a devastating fire in 1973 that destroyed forty-five acres of industrial and residential property. The tax base could be greatly expanded by private redevelopment of the presently tax exempt Naval Hospital site. The marina is considered an important part of the redevelopment effort. It will generate tax revenue, enhance the marketability of the housing, and encourage development of marina-related enterprises such as; restaurants, nautical supply stores and boat sales and repairs. The federal project is considered vital to the successful development of the marina.

THE PROBLEM OF LIMITED RECREATIONAL FACILITEIS AND WATERFRONT ACCESS

The City of Chelsea has only twenty-five acres of recreation space. In addition to the shortage of open space and recreational facilities, Chelsea residents have virtually no public access to their waterfront despite the fact that the City is fronted on three sides by water. Extensive development of the shoreline for industrial purposes limits accessibility.

THE PROBLEM OF INADEQUATE BOAT MOORING SPACE, REPAIR AND STORAGE FACILITIES IN BOSTON HARBOR

The Greater Boston area suffers from a shortage of recreational boat slips due to the great demand for boating and the limited supply of suitable marina facilities. According to the master plan for the Chelsea Naval Hospital Redevelopment, there also exists a shortage of boat repair and storage facilities within the Boston Harbor area. Although there are several marinas in the harbor, shore facilities are apparently not as readily available as in suburban locations where waterfront land is more available for recreational use.

PROBLEMS OF NAVIGATION

Because of the shallow depths in the upper reaches of the Island End River, any proposed channel improvements must provide sufficient space so that all maneuvering can be accomplished within the channel limits. Since many operators of small craft have limited operating and navigational experience relatively straight channel alignments are desirable.

THE PROBLEM OF CONFLICTS WITH EXISTING SHIPPING

Present commercial shipping activities are expected to continue in the Island End River for the foreseeable future. Due to the restricted dimensions of the existing channel and the limited maneuverability of large vessels under tow, conflicts between existing shipping and future recreational boating may develop. This potential problem would be most noticeable if recreational craft were required to use the existing channel.

THE PROBLEM OF SECURITY AT THE EXXON TERMINAL

In general, representatives of the industries on the westerly shore of the Island End River felt that small craft in the river would cause little interference with operations. Although some concern was expressed about accidents if small boats are to use the existing channel, they believed this problem would be alleviated if boaters abide by boating safety regulations.

Representatives of Exxon were more concerned with the potential for an accident with volatile chemicals, such as gasoline or naptha, handled at their terminal. Preference was expressed for a recreational channel location well removed from their terminal.

THE PROBLEM OF POOR WATER QUALITY

At present, water quality in the Island End River is poor. Bottom sediments in the river are polluted with heavy metals and petroleum residues, runoff from urban areas, leachates from solid waste buried near the shoreline and possible discharges from vessels and industrial activities on the Everett side of the river.

The proposed project may impact water quality in several ways. In the short term, dredging will result in deterioration of water quality. Long-term impacts of the project will be due to pollution produced by the recreational boats.

PROBLEMS WITH DISPOSAL OF DREDGED MATERIAL

Ocean disposal of dredged material is controlled by federal regulations. Because the sediment has passed minimum federal bio-assay standards for toxity to marine organisms, ocean disposal will be permitted. However, adverse impacts on water quality and marine organisms will be associated with the discharge of any type of sediment into the ocean.

Disposal for landfill at the site of the proposed Massport Container Facility at the former Naval Base in South Boston also appears to be economically and environmentally feasible if coordination of project schedules can be achieved and if the material from the Island End River proves to be similar in nature to the other materials slated for disposal there. Land disposal appears feasible, however, it is less environmentally desirable and more costly than the methods mentioned above. Under state regulations, land disposal of dredge material must take place on sites approved by the local board of health. It must be confined by dikes or bulkheads and provided with facilities to control effluents. Because of the presence of pollutants, the Massachusetts Department of Environmental Quality Engineering felt that land disposal of the dredged material from the Island End River could be a problem. In addition to its toxic properties, the sediment has poor structural properties. Therefore, the dredged material would not be usable as structural fill material beneath buildings or structures. Due to the large volume of dredged materials, a disposal site must be found near the shoreline to avoid adverse impacts associated with its transport.

PROBLEMS WITH ALTERATION OF THE INTERTIDAL ZONES

The National Marine Fisheries service and the Massachusetts Division of Marine Fisheries expressed concern over the preservation of the intertidal zone. Because the extent of intertidal zone habitat is limited in the inner harbor, efforts should be expended to preserve remaining areas.

PLANNING CONSTRAINTS

MINIMIZE CONFLICTS WITH INDUSTRIAL SHIPPING

Conflicts between commercial shipping and small recreational craft should be minimized both to avoid delays and to reduce potential safety problems. Some interference and delays are likely, especially at low tide, if the existing commercial channel is used by small boats. The safety problems associated with the maneuvering of tug assisted barges and freighters in a confined channel are of greater concern.

The potential also exists for conflicts in the short term between existing commercial shipping and dredging operations. This will be minimized by specifying methods, procedures and scheduling of construction activities.

DISCOURAGE RECREATIONAL BOATING IN THE VICINITY OF THE EXXON TERMINAL

Due to the possibility of an accident involving the volatile chemicals at the Exxon Corporation, the proposed recreational channel should be located at a reasonable distance from the existing commercial channel at the Exxon facilities. Construction of a channel immediately adjacent to the Exxon Terminal could result in sparks or open flames occuring from dredging operations (short term) or from the operation of recreational small craft (long term). The 1973 Uniform Fire Code of the International Conference of Building Officials and the Western Fire Chiefs Association requires that smoking and open flames be prohibited within 50 feet of fueling operations.

MINIMIZE THE AMOUNT OF DREDGING

The total volume of dredge material should be carefully controlled to minimize economic costs, reduce adverse effects on marine life and minimize alteration of the intertidal zone. Secondary adverse impacts will also be associated with the disposal of dredged materials.

AVOID ENCROACHMENT ON THE MDC PROPERTY

The MDC has proposed development of a twenty-six acre park along the edges of the Mystic and Island End Rivers. Since locating the marina within the proposed park would directly conflict with current park plans, the marina facility must be located upstream on the Island End River.

AVOID ALTERATION OF THE EVERETT SHORELINE

The entire Everett shoreline is highly developed and is protected by timber bulkheads or riprap. Any changes to the Everett shoreline would likely require acquisition of property and would probably meet opposition from Everett property owners.

The criteria for locating channel alternatives are discussed in Appendix 4. No marina facilities should be located on the Everett shore as there is insufficient land available for suitable support facilities.

PLANNING OBJECTIVES

Planning objectives are based on consideration of the national objectives of Economic Development (NED) and Environmental Quality (EQ), and the specific problems and needs of the Project Area. The planning objectives are used in the development and the evaluation of alternative plans. In cases where the planning objectives represent conflicting goals, the final plan will incorporate tradeoffs among different objectives.

COORDINATE WITH PLANS FOR THE REDEVELOPMENT OF THE CHELSEA NAVAL HOSPITAL SITE

Encourage the full scale development of the Chelsea Naval Hospital site in conformance with the Master Plan in order to alleviate the problems of a limited tax base and restricted employment opportunities. This can be accomplished by constructing the recommended marina facilities on the Island End River.

COORDINATE WITH THE PROPOSED MDC PARK

Improve the problems of limited recreational facilities and restricted waterfront access for Chelsea residents by encouraging development of the proposed MDC park. The channel improvement plans should be compatible with the concept of a waterfront park.

COORDINATE WITH THE PROPOSED MARINA FACILITIES

Help alleviate the problem of inadequate boat mooring space, repair, and storage facilities by encouraging development of the proposed marina facilities. The channel improvement plans must address the proposed location of the marina and boat launching ramp and the effects of shoreline protection on proposed adjacent land uses.

To date, detailed marina plans have not been developed by the City of Cheslea. Therefore, the channel locations developed in this study may place restrictions on the location and configuration of the subsequent marina development.

PROVIDE FOR SAFETY AND MANEUVERABILITY IN THE PROPOSED CHANNEL

Provide adequate channel width and depth for the types of boats expected to utilize the channel. Due to the anticipated inexperience of many boat operators in the Island End River, a relatively straight channel alignment should be provided to simplify navigation.

FORMULATION OF PRELIMINARY PLANS

A number of preliminary plans were developed based on the planning objectives identified in the previous section. These plans were then screened to determine those most acceptable for further detailed study.

MANAGEMENT MEASURES

In addition to the development of structural solutions to effect navigational improvements, management measures were investigated to determine if the project objectives could be achieved by other means at lower costs. The proposed project consists of dredging a channel in the Island End River to serve a planned marina approximately 2000 feet upstream from the mouth of the river. Because of the constraints placed on the project, there are no feasible means to accomplish this project goal by implementation of management measures only.

Location of the marina further downstream on the Island End River or on the Mystic River is precluded by the intended use of the shoreline as a park. The City of Chelsea would like the marina to be operated by private industry on a long term lease to generate revenue for the City. It is against MDC policy to locate such private facilities within their parks. The marina is also intended to stimulate other tax revenue producing private development on shore, such as restaurants or marina related industries, which would take land intended for park purposes. Therefore, location of a marina and related shore facilities within the limits of a publicly owned MDC park is incompatible with its intended function and with the management policies of the MDC. Even if the problem of disruption of the MDC Park could be alleviated, the suitability of the Mystic River shore as a site for a marina would be limited.

It is anticipated that no structures will be allowed to extend beyond the pier bulkhead line on the Mystic River. Because this line is close to the shore of the Mystic River, the size of any marina facilities will be limited.

PLAN FORMULATION RATIONALE

PROJECTED RECREATION FLEET

The first step in the formulation of alternative plans was to make projections of the number, type and size of boats expected to use the Island End River. The projected fleet characteristics are needed to establish the size and layout of the marina, the need for turning basins, and the dimensions of the access channels.

The projected recreational fleet characteristics were based upon a detailed survey of four marinas considered to be representative of conditions at the Island End River. Additional observations were made at marinas in the Boston Area. The observed fleet dimensional characteristics were categorized separately for sail and motor craft. The proportion of sailboats in the projected fleet was increased over that observed due to anticipated long term changes in the availability and cost of petroleum based fuels. Due to the demand for marina facilities in the Boston Area the size of the projected fleet was determined by the capacity of marina facilities which could be economically provided in the Island End River.

The majority of the projected fleet is expected to be small power boats of less than 30 feet. Only 2% of the craft are expected to be longer than 40 feet. Appendix 6 contains the results of the marina survey and the characteristics of the projected fleet.

MARINA PLANS

In the Master Plan for the Naval Hospital, a 250 boat marina was laid out in concept only. The Master Plan showed the use of the Constitution Magazine Buildings for marina-related commercial enterprises. The existing stone pier behind these buildings was incorporated into the dock facilities. The Reconnaissance Report contained no assumptions about berthing configurations.

During this study, it became necessary to develop marina concepts in more detail to locate the channel and to establish slip capacity.

Two alternative marina plans were developed and are illustrated in Appendix 2, Figures 2-1 and 2-2. Marina 1 is based on the concept shown in the Master Plan. A boat launching ramp is located at the far upstream end of the marina, while docks extend 550 feet downstream and 700 feet upstream from the upgraded existing pier. Marina 1 does not include a turning basin.

Marina 2, shown in Appendix 2, Figure 2-2, is based on locating the marina facilities further upstream on a two acre nonrectangular turning basin.

CHANNEL DIMENSIONS

This study has found that the channel dimensions of 100 feet wide and 6 feet deep as set forth in the Reconnaissance Report, are warranted and will provided an adequate width and depth for the types of craft expected to use the river. The width of 100 feet was found to be warranted based on the the presence of commercial shipping in the lower part of the river and the lack of a turning basin next to the marina. Analysis of alternative channel widths and depths is presented in Appendix 6.

CHANNEL LOCATIONS

Alternative channel locations were developed in consideration of the planning objectives and constraints outlined in the previous section. In general, the channel locations may be described in relation to the commercial channel and the Chelsea shoreline. The alternatives that were developed generally consisted of a) using the existing commercial channel, b) widening the existing channel, or c) creating an entirely separate small boat channel.

PLANS OF OTHERS

The project which will have the greatest influence on the Proposed Water Resources Improvement Project will be the proposed redevelopment of the Chelsea Naval Hospital property by the City of Chelsea. The Island End River project should be considered as an integral part of those plans. Development of the marina and alternative channel alignments have been based on careful coordination with City and MDC plans.

ANALYSIS OF PLANS CONSIDERED IN PRELIMINARY PLANNING

DESCRIPTION OF PLANS

Initial planning efforts are documented in the November 1978 Reconnaissance Report. The project consists of a 2 acre turning basin approximately 300 feet square located at a point 2000 feet upstream from the Mystic River. An access channel 100 feet wide by 6 feet deep is recommended on an alignment generally following the center of the river.

During the early stages of this project, ten alternatives were developed and analyzed. They involved different marina and turning basin options as well as various channel alignment alternatives. They are described as follows:

ALTERNATIVE A-1 This alternative incorporates channel alignment A with marina 1. The existing commercial channel is extended approximately 250 feet to the marina and runs approximately 1200 feet adjacent to the marina 1. The western edge of the channel bottom is located 100 feet from Everett shore high water line.

ALTERNATIVE B-1 - This alternative incorporates channel alignment B with marina 1. This plan involves widening the existing channel for 1000 feet and then extending it 250 feet to marina 1, thus providing an adjacent small boat channel. The existing channel was considered to be 200 feet in width at the Mystic River near the end of the Exxon Terminal; then tapering to 120 feet at the end of the Coldwater Seafood docks.

ALTERNATIVE C-1 - This alternative incorporates channel alignment C with marina 1. This alignment represents the closest that the channel can be located to the Chelsea shoreline without requiring extensive shoreline protection.

ALTERNATIVE D-1 - This alternative incorporates channel alignment D with and marina 1. The channel is located as close to the Chelsea shoreline as possible at the lower part of the river using revetment at a 3:1 slope and maintains the top of the bank. The channel bottom is aligned along the pierhead/bulkhead line at the mouth of the river.

ALTERNATIVE A-2 - This alternative incorporates channel alignment A with marina 2.

ALTERNATIVE B-2 - This alternative incorporates channel alignment B with marina 2.

ALTERNATIVE C-2 This alternative incorporates channel alignment C with marina 2.

ALTERNATIVE D-2 This alternative incorporates channel alignment D with marina 2.

ALTERNATIVE E Under this alternative the channel is located approximately in the center of the river. It represents the closest that a channel can be located to the Chelsea shoreline without requiring any revetment.

ALTERNATIVE F - The channel is generally situated in the same location as under Alternative D. Shore protection is provided by a bulkhead rather than a revetment.

COMPARATIVE ASSESSMENT AND EVALUATION OF PLANS

An evaluation of the marina alternatives indicated that marina "1" was preferable to marina "2" for a number of reasons. In general, a turning basin requires an excessive amount of area within the tidal basin.

Therefore, the cost of development for marina "2" will be higher, because more extensive shoreline protection and a larger amount of dredging (for the marina basin) will be needed. Assuming an upper limit on the per slip development cost of $4,000, and further, assuming that no pier construction would occur along the Everett shoreline, the reasonable berthing capacity of marina "2" is 180 boats.

Marina "1" provides a lower development cost per slip and accomodates about 250 boats. Although a turning basin is not provided with marina "1" most boats expected to use the marina will be power boats less than 40 feet in length. Because they are maneuverable a turning basin is not considered a necessity. Elimination of the turning basin proposed in the Reconnaissance Report will improve the development advantages of the marina "1", reducing the amount of dredged material and reducing overall project costs.

Comparison of the channel location alternatives indicates that there is, in general, a tradeoff between project cost and boating convenience and safety. Because alternatives A-1 and A-2 utilize the existing shipping channel, they require the least amount of dredging and have the lowest overall cost. However, they have the highest potential for accidents and delays because recreational boats will be in close proximity to large commercial ships.

The costs of the alternatives generally increase as the channel alignments are located closer to the Chelsea shoreline because greater amounts of dredging and shoreline protection are required. Although the channel alignments closer to the Chelsea shoreline increase boating safety, they have the disadvantages of creating a larger spoil disposal problem, interfering with marine life in the intertidal zone, and being more costly.

Alternatives B-1 and B-2 create a 100 foot wide small craft channel abutting the commercial channel. While alternatives C-1, C-2 and E provide for a separate channel, the river will be dredged to provide a six foot minimum depth between the commercial and recreational channels. In contrast, alternatives D-1, D-2 and F would leave portions of the river bottom above the 6 foot depth (or even above MLW) between the small boat channel and the commercial channel. These shoals would be covered during intermediate and high tide conditions presenting a hazard to small craft.

CONCLUSIONS

Based upon evaluation of the degree to which each alternative attained the planning objectives and conformed to the planning constraints previously established, alternatives A-1, B-1, C-1 and D1 were selected for further detailed study. For simplicity, these preliminary alternatives were redesignated as Plans A, B, C and D respectively. These plans are evaluated in detail in the following sections of this report.

ASSESSMENT AND EVALUATION OF DETAILED PLANS

This section contains an analysis of the four improvement alternatives selected for detailed study. Evaluation of the alternatives is based on their attainment of the project planning objectives. Although the marina is not a part of the Federal project, its impact has been incorporated.

GENERAL ASSESSMENT AND EVALUATION OF IMPACTS

The general impacts of the Proposed Project which are common to all four alternatives are evaluated below. Impacts which are unique to each alternative are assesed and evaluated in subsequent sections of this report.

IMPACT ASSESSMENT

DREDGING IMPACTS - Dredging operations cause both short term and long term impacts including temporary air, noise and water pollution. The most serious impact is the effects of increased turbidity on shellfish and finfish. For these reasons dredging of the Island End River will be scheduled to take place in the fall, and thereby avoid adverse effects on the anadromous alewides in the Mystic River.

Long term impacts of dredging include removal of existing benthic organisms from the river bottom, removal or alteration of marine habits in the intertidal zone or elsewhere on the river bottom, and alteration of tidal currents.

The predominant marine species expected to be displaced by dredging of the Island End River is the clamworm. It is also expected that dredging will result in the removal of some soft shell clams in the lower reaches of the river. Any long term impacts on these species will be mitigated by natural repopulation of much of the area disturbed by dredging.

All four alternatives will affect the intertidal zone of the river, i.e., the portion of the river bottom between the low and high water lines. Impacts on the intertidal zone increase from Plan A (minimum) to Plan D (maximum). Construction of marina facilities by the City would require additional dredging and removal or alteration of the intertidal zone. However, the impacts are not direct impacts of the Federal Project.

The intertidal zone is eliminated when sections of the river bottom are dredged to a depth below MLW. It will be altered when dredging results in steepening existing bottom slopes between MLW and MHW. The area is a valuable source of organisms at the lower end of the food chain and also a potential habitat for shellfish. Although the intertidal area of the Island End River is currently polluted, shellfish could conceivably be harvested if long term improvements in water quality occur.

The amount of dredging required ranges from 51,800 cubic yards for Plan A to 111,000 cubic yards for Plan D. Construction of the marina basin will require removal of an additional 65,000 cubic yards of material by the developers.

SHORELINE IMPACTS None of the four alternative plans will impact the Everett shoreline. Minimizing involvement with this shoreline is one of the project planning constraints. In Plans C and D, some shoreline protection such as a riprap revetment will be required along the Chelsea side of the river to facilitate construction of the channel.

The marina basin, common to all four alternatives, will require the construction of approximately 1,250 feet of revetment along the Chelsea shoreline.

IMPACTS ON NAVIGATION - At present, recreational boating in the river is limited to an occasional transient craft at intermediate and high tide levels. Apparently no boats are permanently moored in the river. Development of a 250 boat marina and a boat launching ramp will result in extensive recreational use of the river. Plan A, which requires joint use of the existing channel by recreational craft and large ships, will cause some disruption to navigation.

Plans B through D have less significant negative impacts on existing shipping in the river.

SOCIAL AND COMMUNITY IMPACTS - The proposed Project will have a beneficial impact on the City of Chelsea's plans for redevelopment of the Chelsea Naval Hospital property. Full scale redevelopment of the Naval Hospital will in turn enhance the ability of the City to provide better community services through added revenues by increasing the limited tax base of the City. The project will also have the beneficial effect of increasing recreational opportunities for the residents of Chelsea and nearby communities.

ECONOMIC IMPACTS - Economic impacts of the proposed project have been evaluated by determining the estimated costs and benefits. The cost estimates are based upon consideration of numerous factors including the following:

the quantities of dredge material
mobilization and demobilization
equipment costs and wage rates
anticipated dredging rates in cubic yards per hour
engineering
supervision
administration and
contingencies

Equivalent annual costs have been calculated for the purpose of the - benefit/cost analysis. These costs have been determined using the anticipated 1980 rate of 7-1/8 percent.

Benefits of the proposed project have been calculated on the assumption that a marina for 100 boats will be completed by 1982 and will be gradually expanded to a maximum of 250 boats by 1992. Calculation of project benefits is based on a procedure using the estimated annual return on the owner's investment in his boat, a measure of his "willingness to pay" for recreational facilities. The method of projecting the boat fleet and detailed benefit/cost calculations are contained in Appendix 6.

MITIGATION REQUIREMENTS

Mitigation measures would include steps to control the temporary noise, air and water pollution due to dredging equipment. Dredging would be scheduled to take place during the fall months so as to avoid suspension of water pollutants during the spring alewife run in the Mystic River.

IMPLEMENTATION RESPONSIBILITIES

COST ALLOCATION - Onehundred percent of the cost of the project is allocated to the recreational channel. There are no other components in the Federal Project.

COST APPORTIONMENT - The Federal government is responsible for 50 percent of the initial cost of the Federal project and for 100% of the local responsibilities. Federal and local costs vary for each of the alternatives.

FEDERAL RESPONSIBILITIES - The Federal Project consists of dredging the access channel only. The Federal Project does not include any marina facilities, shoreline protection, or site work at any land disposal areas.

NON-FEDERAL RESPONSIBILITIES - The specific local requirements as contained in the Rivers and Harbors Act are as follows:

(1) Provide a cash contribution toward construction costs, determined in accordance with existing policies for regularly authorized projects, in view of recreational benefits, land enhancement benefits or similar type special and local benefits expected to accrue.

(2) Provide, maintain and operate without cost to the United States, an adequate public landing with provisions for the sale of motor fuel, lubricants and potable water, open and available to the use of all on equal terms.

(3) Provide without cost to the United States all necessary lands, easements and rights-of-way required for construction and subsequent maintenance of the project including suitable dredged material disposal areas with necessary retaining dikes, bulkheads and embankments.

(4) Hold and save the United States free from damages that may result from construction and maintenance of the project.

(5) Accomplish without cost to the United States alterations and relocations as required in sewer, water supply, drainage and other utility facilities.

(6) Provide and maintain berths, floats, piers, and similar marina and mooring facilities, as needed for transient and local vessels, as well as necessary trailer facilities, access roads, parking areas and other needed public use shore facilities, open and available to all on equal terms. Only minimum, base facilities and services are required as part of the project. The actual scope or extent of facilities and services provided over and above the required minimum is a matter of local decision. The manner of financing such facilities and services is a local responsibility.

(7) Assume full responsibility for all project costs in excess of the Federal cost limitation of $2,000,000 under the 107 program.

(8) Establish regulations prohibiting the discharge of untreated sewage, garbage, and other pollutants into the waters of the harbor.

It should be noted here that although item number (6) above requires that local governments need provide only the basic, minimum facilities, the benefits estimated for this project are dependent on the extent of the mooring facilities provided by the City. This study has assumed that the City of Chelsea will provide marina facilities with a maximum capacity of 250 boats as stated in the Chelsea Naval Hospital Redevelopment Master Plan.

This study has found that although it will prove costly, construction of a 250 boat marina in the Island End River is feasible. The estimated cost for construction of the marina, exclusive of floats, piers, utilities and shore facilities is about $800,000, or over $3200 per berth. Because revenues from leasing of berth space will probably not cover the City's initial cost, construction of the marina must be considered as a public investment.

The following sections of this report consist of an assessment and evaluation of impacts which are specific to the individual alternative plans.

PLAN A

PLAN DESCRIPTION

Near the river's mouth, Plan A would involve joint use of the existing channel by recreational and commercial craft. The small craft channel would be dredged 1300 feet beyond the upstream end of the existing commercial channel. The upstream channel would be 100 feet wide by 6 feet deep at mean low water. It would be located roughly 80 to 100 feet from, and parallel to, the Everett shoreline. Plans A, B, C and D are all based on the assumption that a marina and boat launching ramp will be constructed with the approximate configuration shown in Figure 2-1.

The area to be dredged for the channel generally follows the MLW stream bed. The present elevation of the river bottom in the area of the proposed channel ranges between 1-1/2 feet below to about 3 feet above mean low water.

IMPACT ASSESSMENT

DREDGING IMPACTS - Plan A requires that 51,800 cubic yards of material be dredged. Additionally, 2.2 acres of intertidal area would be removed and 1/2 acre of intertidal area would be altered for the Federal access channel. Additional dredging and intertidal zone modificaton would be required for the marina basin, however, this is a local responsibility and not directly attributable to the Federal project.

SHORELINE IMPACTS - The Plan A channel does not result in any shoreline changes.

IMPACTS ON NAVIGATION - Since Plan A involves the joint use of the existing channel for both commercial and recreational craft, it would have an adverse impact on existing shipping. There may be some minor delays to shipping, although, legally, the larger, less maneuverable ships have the right of way. Recreational craft would be forced to wait for the barges and freighters to be maneuvered in the narrow channel. Based on the number of shipping operations, it is estimated that the recreational benefits of Plan A would be reduced about 7% due to delays.

Safety factors are more difficult to quantify. The primary dangers of joint use of a channel by ships and small craft are those of collisions due to a small boat cutting across the path of a larger craft and the potential of a small boat coming too close to the turbulent wash produced by the large commercial tugs. These problems would be of greatest concern for inexperienced boaters who might be unaware of the dangers. It should be noted that shared use of channels by commercial ships and recreational boats is common in harbor areas.

Although no quantitative assessment of the safety impacts have been made, Plan A is considered to have an adverse impact in this regard.

ECONOMIC IMPACTS - Dredging disposal costs are based upon disposal at sea. If subsurface conditions vary from those anticipated or if land disposal of dredged material is required, then the estimated costs would be subject to change.

The estimated first cost of Plan A is $518,000. The equivalent annual cost based on an interest rate of 7-1/8% is $53,000. The annual project benefit is estimated at $295,300.

Annual costs and benefits are shown below.

Annual Costs	Annual Benefits	B/C Ratio	Net Benefits
$57,000	$295,300	5.2	$238,300

EVALUATION AND TRADEOFF ANALYSIS

By utilizing the existing commercial channel, Plan A minimizes dredging requirements. Therefore this alternative has the lowest initial as well as annual maintenance cost. It also has the least impact on existing marine life in the river, since no dredging will take place in the lower section of the river.

Plan A, however, has an adverse impact on boating convenience and safety arising from shared use of the commercial channel. It also presents a secondary safety problem which is difficult to quantify. Plan A would require recreational craft to pass in close proximity to the Exxon terminal where large volumes of volatile substances are handled and stored.

Plan A would have virtually no impact on the existing envirionmental conditions downstream of the marina site, resulting in the maximum preservation of the intertidal areas. It would have no positive aesthetic impacts, however, as extensive mudflats would remain adjacent to the proposed waterfront park.

A major disadvantage of Plan A is that the existing channel will be taken over by the Federal government. This channel has been dredged and maintained using private funds exclusively. Once it is taken over by the Federal government, future private sector alteration of the channel would probably be precluded. For example, privately funded dredging of the channel would probably be inhibited due to difficulties of private industries deepening a federally controlled channel. While the industries on the Everett shore require approximately a 24 foot deep channel at MLW, the Federal channel will only be maintained to a six foot depth at MLW. Thus, as sedimentaion occurs, the channel will eventually become unusable for the firms who initially funded its construction and intial maintenance. Thus, the present users of the channel, which are entirely within the City of Everett, would be placed at a disadvantage for a project initiated by and intended primarily to benefit the City of Chelsea.

COST APPORTIONMENT

The local share of the costs of the Federal project for Plan A is estimated at $259,000 plus a 100% share of related shore improvements which are not part of the Federal Project.

PUBLIC VIEWS

VIEW OF FEDERAL AGENCIES The United States Coast Guard Office of Marine Safety recommended that the shared channel not be recommended due to potential safety problems. The U.S. Fish and Wildlife Service recommended that the plan be selected because it minimizes impacts on marine life. Appendix 3 contains copies of statements from these agencies.

VIEWS OF NON-FEDERAL AGENCIES AND OTHERS Use of the existing commercial channel was generally not viewed favorable by the industries in Everett, currently using the channel. The industries were generally more concerned with trespass problems rather than possible boating accidents. A representative of Exxon Corporation felt that the small boat channel should be separated from the commercial channel.

PLAN B

PLAN DESCRIPTION

Plan B involves construction of a separate channel for recreational craft parallel to and contiguous with the existing commercial channel. Upstream of the commercial channel the alignment of the recreational channel would generally correspond to that in Plan A.

The boundary of the existing shipping channel is somewhat irregular. For the purposes of this study, the channel was considered to be 200 feet in width from the Mystic River to a point 400 feet upstream. It then tapers to 120 feet in width at the end of the Coldwater Seafood wharves. These dimensions provide for a channel slightly wider than the existing one. At present, the channel is somewhat restricted at low water, especially in the area of the Marquette Cement Corporation wharves. The dimensions described above will allow future widening of the existing commercial channel at its present 24 foot depth. This will allow vessels bound for the Coldwater Seafood Corporation wharves to maneuver past barges berthed at the Marquette wharves.

The small boat channel would be constructed by dredging a "shelf" along the edge of the deeper channel. Presently the western edge of the channel in Plan B is generally at or near the desired 6 foot depth. The eastern edge is generally at an elevation of 0 to 2 feet above MLW.

IMPACT ASSESSMENT

DREDGING IMPACTS - Plan B requires the dredging of approximately 64,100 cubic yards for the access channel. Plan B involves removal of 3.0 acres of intertidal area and the alteration of 1.0 additional acres. Construction of marina facilities by the City would require additional dredging and removal or alteration of the intertidal zone, however, the impacts are not direct impacts of the Federal Project.

SHORELINE IMPACTS - Plan B does not result in any changes to the existing shoreline.

NAVIGATON IMPACTS - Plan B would have minimal impacts on the existing industrial shipping operations. The small boat channel would be placed adjacent to the existing channel, allowing small boats to pass the larger craft more freely even at low tides.

The safety problems inherent in Plan A are greatly reduced but are not eliminated. Even though a separate channel would be provided for small boats, it is likely that some would stray into the existing channel. In addition, the wash generated by the large tug boats would generate waves in the small boat channel.

ECONOMIC IMPACTS - The initial cost of the Federal Project for Plan B is $629,000. The equivalent annual cost is estimated at $64,390 at an interest rate of 71/8%. Project benefits are estimated at $317,500 annually.

Annual Costs	Annual Benefits	B/C Ratio	Net Benefits
$68,000	$317,500	4.7	$249,500

EVALUATION AND TRADE-OFF ANALYSIS

Construction of a separate, parallel recreational channel in the lower portion of the Island End River can be accomplished with a relatively modest increment in the quantity of dredging required by Plan A. Much of the area within the proposed recreational channel in the lower potion of the river is already deeper than 6 feet at MLW and will therefore not require dredging. The modest additional amount of dredging will increase boating safety and convenience by providing a separate recreational channel. The separate channel would mean that the existing channel need not be taken over by the Federal government. The industrial concerns would be free to utilize, modify, and maintain the existing channel within the limitation of existing laws, codes and regulations.

COST APPORTIONMENT

Local government would be responsible for payment of an estimated $314,500 which is 50% of the initial cost of the Federal project. Local responsibility also includes a 100% share of related shore improvements which are not a part of the Federal Project.

PUBLIC VIEWS

Views of Federal Agencies - The U.S. Coast Guard, Office of Marine Safety felt that a plan which widens the existing channel would provide the best solution.

View of Non-Federal Agencies and Others - At a review meeting on August 9, 1979, representatives of the Massachusetts Office of Coastal Zone Management and the Division of Marine Fisheries stated their preference for Plan A based on the minimum dredging related impacts. They agreed, however, that additional economic and envirionmental costs could be justified in order to provide the incremental safety benefits.

PLAN C

PLAN DESCRIPTION

PLan C involves construction of a channel for recreational craft on an alignment that is completely separated from the existing commercial channel. At the mouth of the river the small boat channel would be located about 280 feet from the Exxon Corporation wharves. Upstream, the Plan C channel tapers towards the commercial channel. Two small bends are located in the channel, the second at the point where the proposed marina would begin.

The channel location in Plan C generally corresponds to that shown in the Reconnaissance Report. It is as near to the Chelsea shoreline as possible without requiring extensive revetment to provide shore protection.

IMPACT ASSESSMENT

DREDGING IMPACTS - Plan C requires the dredging of 89,700 cubic yards of material. Approximately 4.9 acres of intertidal zone area will be removed and an additional 1.9 acres will be altered. Additional dredging and intertidal zone impacts would result from constraints of the proposed marina. These impacts are only indirectly attributable to the Federal project.

SHORELINE IMPACTS - Plan C would require revetment along 200 feet of shoreline to maintain the stability of the desired slopes.

NAVIGATION IMPACTS - Plan C provides a channel that is completely separate from the commercial channel. Although the project benefits of Plan C would be approximately the same as Plan B, a somewhat higher level of safety and convenience would be provided.

ECONOMIC IMPACTS - The estimated first cost of Plan C is $872,000. The equivalent annual cost is $88,980 at a 7-1/8% interest rate. Project benefits are estimated at $317,500 annually.

Annual Costs	Annual Benefits	B/C Ratio	Net Benefits
$95,000	$317,500	3.3	$222,500

EVALUATION AND TRADE-OFF ANALYSIS

Plan C provides a separation zone between the commercial and the small boat channels at the expense of additional dredging, however, Plan C has a greater adverse effect on intertidal zones.

COST APPORTIONMENT

Local government would be responsible for 50% of the initial cost of the Federal Project at a cost of $436,000. Local responsibility also includes a 100% share of related shore improvements which are not part of the Federal Project.

PUBLIC VIEWS

VIEWS OF FEDERAL AGENCIES - The National Marine Fisheries Service believes that Plan C will produce an excessive impact on the intertidal zone.

VIEWS OF NON-FEDERAL AGENCIES - The Massachusetts Office of Coastal Zone Management and the Massachusetts Division of Marine Fisheries also believe that Plan C will have an excessive impact on the intertidal zone.

PLAN D

PLAN DESCRIPTION

In Plan D, the small boat channel is aligned as closely to the Chelsea shoreline as possible, providing the maximim separation zone between the small craft and commercial channels. The western edge of the proposed channel is separated from the Exxon terminal docks by approximately 380 feet. This alignment requires approximately 580 feet of revetment along the Chelsea shoreline.

IMPACT ASSESSMENT

DREDGING IMPACTS - The dredging impacts of Plan D are summarized in Table 3. Plan D would require the dredging of approximately 110,100 cubic yards of material, the removal of 6.2 acres of intertidal zone and alteration of an additional 2.3 acres of intertidal zone. In addition to the above, construction of marina facilities, which are not part of the Federal Project, will cause additional dredging and intertidal zone impacts.

Plan D has the greatest impact of any plan on the intertidal zones near the mouth of the river where marine life is to be found in greater diversity.

SHORELINE IMPACTS - Because the channel alignment in Plan D is so close to the shoreline, revetment would be required to maintain the channel side-slope stability. At locations where the revetment would be required the shoreline is presently suffering from erosion.

NAVIGATION IMPACTS - Plan D enhances safety and convenience by providing a maximum separation of the small boats and large ships. However, Plan D would leave potentially hazardous shoals between the small boat channel and the commercial channel.

Some of these points in the river bottom would expose rocky surfaces 2 to 4 feet above MLW. These shoals would be covered at interim tides. Although they would be outside of the small boat channel they could represent a hazard to boaters.

ECONOMIC IMPACTS - Plan D would have an initial cost of $1,058,000 and an equivalent annual cost of $107,800 based upon an annual interest rate of 71/8%. Annual benefits are estimated at $317,500.

Annual Costs	Annual Benefits	B/C Ratio	Net Benefits
$117,000	$317,500	2.8	$202,500

EVALUATION AND TRADE-OFF ANALYSIS

Plan D has the maximum cost and requires the greatest amount of dredging and shoreline protection. Although Plan D has the greatest environmental impacta, it is the plan most prefered by the City of Chelsea. The City prefers that the channel be located close to its shoreline as they desire to have open water as close to the park as possible.

COST APPORTIONMENT

Local government would be responsible for the payment of an estimated $529,000 which is 50% of the initial cost of the Federal Project. Local responsibility also includes a 100% share of related shore improvements which are not part of the Federal Project.

PUBLIC VIEWS

VIEWS OF FEDERAL AGENCIES - At the review meeting cited earlier, the National Marine Fisheries Service expressed the belief that Plan D has an excessive adverse impact on the intertidal zone.

VIEWS OF NON-FEDERAL AGENCIES - The Massachusetts Office of Coastal Zone Management and Massachusetts Division of Marine Fisheries also felt that Plan D will have a more substantial impact than the other alternatives. The City of Chelsea favors a plan that will result in a maximum dredging effort which they feel will enhance the aesthetic quality of the river by providing an increased area of open water at low tide. Representatives of the Exxon Corporation expressed an opinion in favor of having the small boat channel located as far as possible from their terminal. Thus, Plan D best fulfills the desires of the City of Chelsea and Exxon Corporation.

COMPARISON OF DETAILED PLANS

COMPARISON OF PLANS

In general, there is a tradeoff between the increased separation between the recreational and commercial channels and the minimization of project economic and environmental costs. While all four plans have net benefits and B/C ratios significantly greater than one, these ratios decrease as the channel is moved closer to the Chelsea shoreline.

Although Plan A has the highest benefit-cost ratio, net benefits (benefits minus costs) are greater for Plan B than for Plan A. Net benefits for Plan C are lower than those of either Plan A or Plan B. Plan D has the lowest net benefits. Generally, environmental impacts increase in severity from Plan A to Plan D. Plan D has a significant adverse effect on the intertidal zone at the mouth of the river where a greater diversity of marine life currently exits.

Aesthetic impacts are considered most positive for Plans C and D due to the increase in open water area at low tide. The City of Chelsea considers increasing the area of open water to be an important factor for enhancing the appearance of the Island End River when viewed from the luxury housing or the waterfront park on the former Naval Hospital property. Plans C and D would eliminate the mud flats by bringing the low water line closer to the Chelsea shoreline. Plans A and B would have minimal impacts on areas close to shore, downstream of the marina.

Plan A has lower navigation benefits than Plans B, C, and D, due to delays encountered by recreational boats when passing by the industrial wharves and conflicting with commercial shipping. The navigational benefits of the other plans are essentially the same, although there is a difference in an unquantifiable safety factor. Plan B is considered significantly better than Plan A in this respect. Plans C and D provide few additional safety benefits beyond Plan B. Plan D introduces the potential safety problem of shoals between the commercial and recreational channels.

RATIONALE FOR DESIGNATION OF THE NED PLAN

Plan B has been designated as the NED plan based on the criteria of the highest net benefits.

RATIONALE FOR DESIGNATION OF EQ PLAN

Plan A has been designated as the EQ plan because it has the least overall environmental impacts. Plan A results in the lowest dredging requirements.

RATIONALE FOR THE TENTATIVELY SELECTED PLAN

Plan B is recommended for implementation. It provides maximum net benefits, while its environmental impacts are not significantly greather than Plan A. In the short term it will require only a 23% increase in the quantity of dredging above that required for Plan A. In the long term it will require an increase of only 36% in the area of intertidal zone to be removed above that required by Plan A. Plans C and D require substantially greater intertidal zone removal and dredging. Plan B enhances social well being. It affords greater safety benefits and minimizes potential interference and delays by providing a separate channel for small craft. Plan B is compatible with redevelopment of the Chelsea Naval Hosptial site as are Plans A, C and D. Long term positive impacts on regional development should also be comparable for all plans. Short term employment under Plan B will be greater than that provided by Plan A but less than that provided by plans C and D. Secondary short term construction employment impacts for the marina and related shore facilities will be comparable under all plans.

APPENDIX 1

PROBLEM IDENTIFICATION

APPENDIX 1
PROBLEM IDENTIFICATION

SECTION A

ANALYSIS OF EXISTING CONDITIONS AND TRENDS

1. This appendix contains information supplementing the first two sections of the Main Report: Introduction and Problem Identification. This appendix describes previous studies and reports, describes the existing and projected future (without project) conditions, identifies problems and sets forth the national objectives the planning objectives and constraints developed for this project.

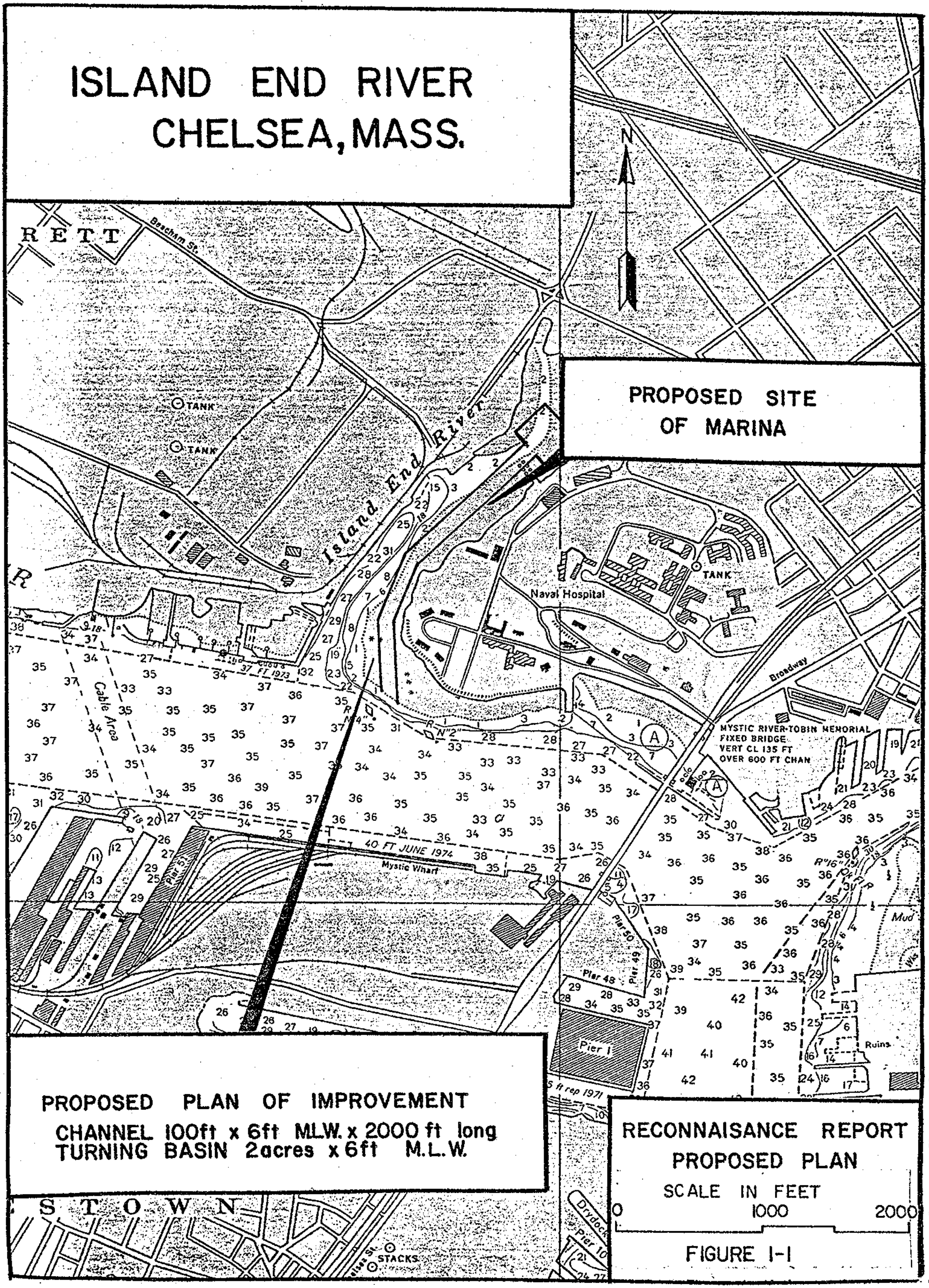
PRIOR STUDIES AND REPORTS

2. The impetus for the current project resulted from the closing of the Chelsea Naval Hospital in 1974. When the Federal government declared the property as surplus, several studies were undertaken to evaluate the conversion to civilian uses.

3. In 1974 Justin Gray & Associates prepared a study for the City of Chelsea, entitled A Recommended Plan for the Reuse of the Naval Hospital - Chelsea, Massachusetts, which proposed construction of marina facilities on the Island End River.

4. Marina development and dredging of a channel in the Island End River were evaluated further in the Development Master Plan and Feasibility Analysis - Chelsea Naval Hospital. This study was performed using funding from the Economic Development Administration of the U.S. Department of Commerce. In addition to housing and a waterfront park, the Master Plan proposed that a portion of the property be used for industrial and commercial development. A marina serving 250 boats and a site for associated industries were the primary focus of the industrial/commercial redevelopment area. Dredging of the Island End River to provide a navigable channel to the marina site was proposed in this report. Exhibits 1-1 through 1-11 which are excerpts from the Development Master Plan provide an overview of the redevelopment plans for the former Naval Hospital property.

5. In November, 1978, the New England Division of the U. S. Army Corps of Engineers prepared a Small Boat Navigation Project Reconnaissance Report to determine the need for further detailed study of navigation improvements in the Island End River. The Reconnaissance Report set forth a conceptual plan for an access channel and turning basin as illustrated in Figure 1-1. The proposed project consisted of a two-acre turning basin, approximately three hundred feet square located at a point two thousand feet upstream


ISLAND END RIVER
CHELSEA, MASS.
PROPOSED SITE OF MARINA
Island End River
Naval Hospital
TANK
Broadway
Beacham St.
Cable Area
37 FT 1973
40 FT JUNE 1974
Mystic Wharf
MYSTIC RIVER-TOBIN MEMORIAL FIXED BRIDGE VERT CL 135 FT OVER 600 FT CHAN
Pier 1
Pier 48
Pier 49
Pier 50
Mud
Ruins
STACKS
PROPOSED PLAN OF IMPROVEMENT
CHANNEL 100ft x 6ft MLW. x 2000 ft long
TURNING BASIN 2acres x 6ft M.L.W.
RECONNAISANCE REPORT
PROPOSED PLAN
SCALE IN FEET
0
1000
2000
FIGURE I-1

from the Mystic River. An access channel one hundred feet wide by six feet deep at MLW was proposed on an alignment generally following the center of the river. The Reconnaissance Report indicated the project would have a benefit:cost ratio of 10.2 and recommended that further detailed study be undertaken.

LOCATION

6. The Island End River is located approximately two miles north of down town Boston in the heart of the Boston Metropolitan area. The river forms a portion of the boundary between the Cities of Chelsea and Everett, and coincidentally Middlesex and Suffolk counties. The Island End River enters the Mystic River about one-half mile upstream of the confluence of the Mystic and Chelsea Rivers, and about one and one-half miles upstream of Boston Harbor.

SOCIAL AND ECONOMIC CHARACTERISTICS OF THE STUDY AREA

7. POPULATION AND EMPLOYMENT

Everett and Chelsea are small cities, and both can be considered characteristic of older central urban areas. In recent years, population of the Boston Metropolitan Area has increased, while the populations of Everett and Chelsea have declined.

8. The 1970 Boston Metropolitan Area population was 2.8 million. Chelsea's 1970 population was 30,639, down 11% from the 1960 census and down from the city's maximum population of 47,000 in 1925. The Metropolitan Area Planning Council estimates continued declines, projecting a 1990 population of 23,000. Like that of Chelsea, the population of Everett has also declined. Its 1970 population of 42,478 is projected to decrease to 37,500 by 1990.

9. As in many older urban areas, median age is higher and educational levels are lower in Chelsea and Everett than the average for the metropolitan area. In 1970, sixty-five percent of the metropolitan area population over twenty-five completed high school while the comparable figure for Chelsea was forty-one percent. Both cities have diverse ethnic populations with recent increases in the Hispanic and Portuguese communities.

10. While the majority of workers in Chelsea and Everett are classified as white collar, the percentage of white collar workers is lower than the regional average. The percent of workers in the blue collar occupations, such as craftsmen, operatives and laborers, is forty-one percent in Chelsea, compared to twenty-eight percent for the Boston Metropolitan Area.

11. Most workers in Chelsea and Everett are employed fairly close to their homes. In the City of Chelsea, approximately seven percent of the workers are employed in downtown Boston, twenty-six percent in other parts of the City of Boston and thirty-eight percent in other parts of Suffolk County, including Chelsea. Twenty percent of Chelsea workers walk to work, a proportion more than double the regional average. Few Everett and Chelsea workers have jobs outside of Suffolk and Middlesex counties.

12. The Cities of Everett and Chelsea have unemployment rates slightly higher than that of the metropolitan area. Median family incomes in the two cities are lower than state and regional averages with the City of Chelsea having the lowest per capita income of any city in Massachusetts. In 1970, median family income was $8,973 in Chelsea and $10,086 in Everett, compared to $11,449 in the metropolitan area. In Chelsea, eleven percent of the families had incomes below the poverty level as compared to six percent in the Boston Metropolitan area. By contrast, the City of Everett has a lower percentage of families at the poverty level than the regional average. Table 1-1 summarizes the social and economic characteristics of the cities of Everett and Chelsea.

Table 1-1
1970 Census of Population
Social and Economic Characteristics

	City of Chelsea	City of Everett	Boston Metropolitan Area
Population	30,639	42,500	2,753,804
Median Age (Year)	31.9	32.0	29.1
Median Household Size (Persons)	3.09	3.05	2.91
Median School Years Completed	11.1	11.7	12.4
Occupation (Percent)			
Manufacturing	28.1	28.2	22.4
White Collar	47.5	47.6	59.6
Government Work	17.9	15.7	15.6
Civilian Labor Force-Unemployed (Percent)	3.8	4.6	3.5
Families			
Median Income	8973	10086	11449
Percent Below Poverty Level	11.0	5.8	6.1
Children Born Per Woman Ever Married	2.95	2.61	2.83
Year Round Housing Units			
Percent Owner Occupied	27.0	41.9	50.7
Percent Rental Units	67.7	55.2	45.8
Percent Vacant/Other	5.3	2.9	3.5
Percent Moved Into Present House 1949 & Earlier	18.7	26.9	17.5
All Workers	12,087	17,602	1,122,516
Means of Transportation (Percent)			
Automobile	48.8	62.3	67.0
Bus	21.4	14.4	11.5
Subway or RR	7.1	12.2	7.8
Walk	20.0	8.7	9.9
Work at Home/Other	2.7	2.3	3.8

Table 11-1 (Continued)
1970 Census of Population
Social and Economic Characteristics

	City of Chelsea	City of Everett	Boston Metropolitan Area
All Workers (continued)			
Place of Work			
Boston Central Business District	7.2	10.0	7.1
Remainder City of Boston	26.4	24.8	26.2
Remainder Suffolk County	37.7	4.3	2.4
Middlesex County	13.4	48.8	29.8
Remainder Metropolitan Area	4.5	5.5	22.5
Outside Metropolitan Area	2.6	2.2	4.6
Automobiles Available Per Occupied Housing Unit (Percent)			
None	44.8	26.8	24.0
1	45.4	58.1	49.0
2 or more	9.9	15.1	27.1

13. ECONOMY

The major industries in Chelsea and Everett are manufacturing and wholesale trade. The area serves as an important production and distribution center serving markets throughout the Boston area and beyond. Because Chelsea and Everett are employment centers, a fairly large number of persons are employed in these Cities relative to the resident population.

14. In the City of Chelsea, manufacturing concerns provide more than fifty percent of the city's 11,000 jobs. The principal industries include metals, electrical machinery, stone, clay, glass, paper and rubber and plastics. These Cities also serve as a major storage and distribution center for various petroleum products and natural gas. The Exxon Corporation has a major terminal facility in the area. A liquified natural gas terminal is located in Everett on the Mystic River between the Tobin Memorial and Broadway bridges. The LNG facility docks some 18 tankers per year or an average of one every twenty days.

In recent years, the Cities of Chelsea and Everett have become an important wholesaling and distribution center for fruit and vegetable produce.

15. LAND USE

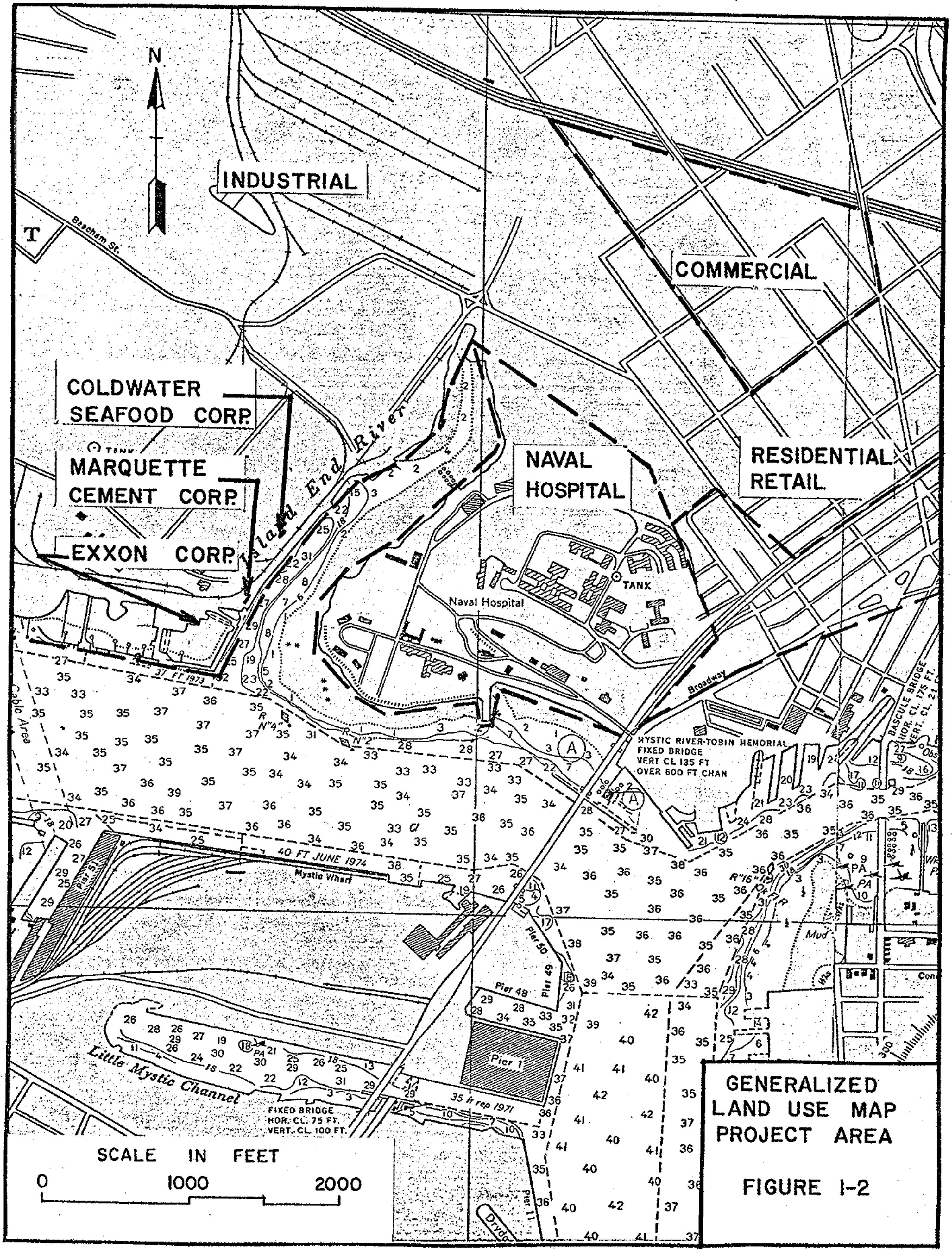
Land use in both Everett and Chelsea, is characterized by residential areas in the central and northern parts of the city and industrial development to the south and along the waterfronts. In both cities commercial areas and municipal land uses tend to be found near the principal north-south streets.

16. With the exception of the Chelsea Naval Hospital grounds, most of the waterfront along the Chelsea, Mystic, Island End and Malden Rivers is devoted to industrial uses. As shown in Figure 1-2, land use along the shoreline of the Island End River is characterized by the intensively developed industrial area on the Everett side and by the relatively undeveloped grounds of the former Chelsea Naval Hospital on the Chelsea side. This undeveloped land provides an opportunity for a much needed waterfront recreation area.

17. On the western shoreline at the mouth of the Island End River, an Exxon Corporation terminal fronts on the Mystic and Island End Rivers. Berths for oil tankers are located along the Mystic River while berths for smaller barges extend about 350 feet north along the Island End River waterfront. Petroleum products including gasoline, fuel oil and asphalt are transferred by pipeline to and from bulk storage facilities nearby.

18. North of the Exxon Corporation terminal are the Marquette Cement Company and the Coldwater Seafood Corporation. These companies maintain berthing facilities on the Island End River that are used on a regular basis by barges and freighters.

19. North of the Coldwater Seafood Corporation, land uses abutting the river consist of small industries. Abandoned wharves extend an additional six hundred feet north along the shoreline. At the northern end of the river on the Everett shoreline, the river borders a parking lot behind a



GENERALIZED LAND USE MAP PROJECT AREA

FIGURE 1-2

produce warehouse. A rail spur extends along the shoreside of the wharves between the end of the Exxon Corporation property and the produce warehouse.

20. North of the river, land uses consist primarily of industrial and warehouse structures with some commercial facilities intermixed. A bank and a large Polaroid manufacturing plant are located immediately to the north of the river. The easterly shore of the Island End River borders the Chelsea Naval Hospital site. The site contains sixty-eight vacant structures, including the main hospital building, living quarters, storage buildings, a maintenance shop, a garage, laboratories and supporting facilities. The property is under the jurisdiction of the General Services Administration until conversion to civilian use can be completed.

NATURAL RESOURCES AND ENVIRONMENTAL SETTING

21. TOPOGRAPHY AND GEOLOGY

At one time the Island End River drained an extensive salt marsh which occupied presently developed areas of Everett and Chelsea. The river formerly followed a course which curved to the west from its present terminus and then in a semicircle back again to the east to an area of the Naval Hospital. Figure 1-3 shows the former course of the river as it appeared in 1884. Over the years, the marsh was filled in to provide land for urban development, reducing the river to its present size. Most of the land to the north and the west of the river is therefore reclaimed land. The land is relatively flat and lies at an elevation of fifteen to twenty feet above MLW. The fill consists of miscellaneous material such as sand, gravel, cinders and rubble in a layer up to fifteen feet thick.

22. Beneath the fill there is apparently a layer of soft highly organic silt and peat which formed by natural surficial deposition of alluvium in the saltwater marshes. These strata generally vary from two to twenty feet in thickness. Beneath the surface strata of silt and peat there is reportedly a layer of Boston Blue clay, ranging from fifteen to one hundred ten feet in thickness. Strata thickness increase to the west. The clay was deposited by the Wisconsin Glacier in adjacent morainal pools. Figure 1-4 illustrates the surficial geological features of the project area.

23. Dense glacial till consisting of sand and gravel with cobbles and bolders is found beneath the Boston Blue clay layer. To the west and north of the river the till is generally located at depths of sixty to one hundred feet.

24. To the east of the Island End River, at the location of the Chelsea Naval Hospital grounds, the topography and subsurface conditions change radically. The Naval Hospital site occupies a glacial drumlin rising about one hundred twenty feet above MLW. From the highest point of the site the ground slopes regularly to a flat area along the southwestern and western part of the property bordering the Island End and Mystic Rivers. The flat area extends inland from the shoreline at an elevation of twenty above MLW. A steep bank drops from this flat area to the edge of the river.

25. Subsurface conditions in the Island End River are likely to vary from east to west. To the east the glacial till is found close to the surface of the ground, and some boulders are visible in the river bottom and along the bank at the eastern edge of the river. The layer of till slopes downward to the west and is found at significant depths to the west of the river.

26. CLIMATE, WAVES, CURRENTS AND TIDES

The climate of the project is affected by its proximity to the Atlantic Ocean. Temperature ranges are moderated somewhat by the ocean and average from twenty-eight degrees Farenheit in January to seventy-one degrees Farenheit in July. The prevailing wind direction is northwest while predominant summer winds are southwest. Occasionally, hurricanes and other severe storms have entered the area.

27. Icing of the Mystic River and Boston Harbor occurs during the colder winters with ice occasionally remaining for a period of one or two months. The Harbor is often ice-free during milder winters.

28. Mean tidal range in the Island End River is 9.5 feet with a spring range of approximately 11.0 feet. Storm water levels of up to 3 feet above mean high water (MHW) are are likely to occur during winter northeast storms. Low tides of 2.0 feet below MLW occur regularly with the average yearly lowest tide of 3 feet below MLW. Extreme low tides are likely to occur in winter months when strong northwest winds drive the water offshore.

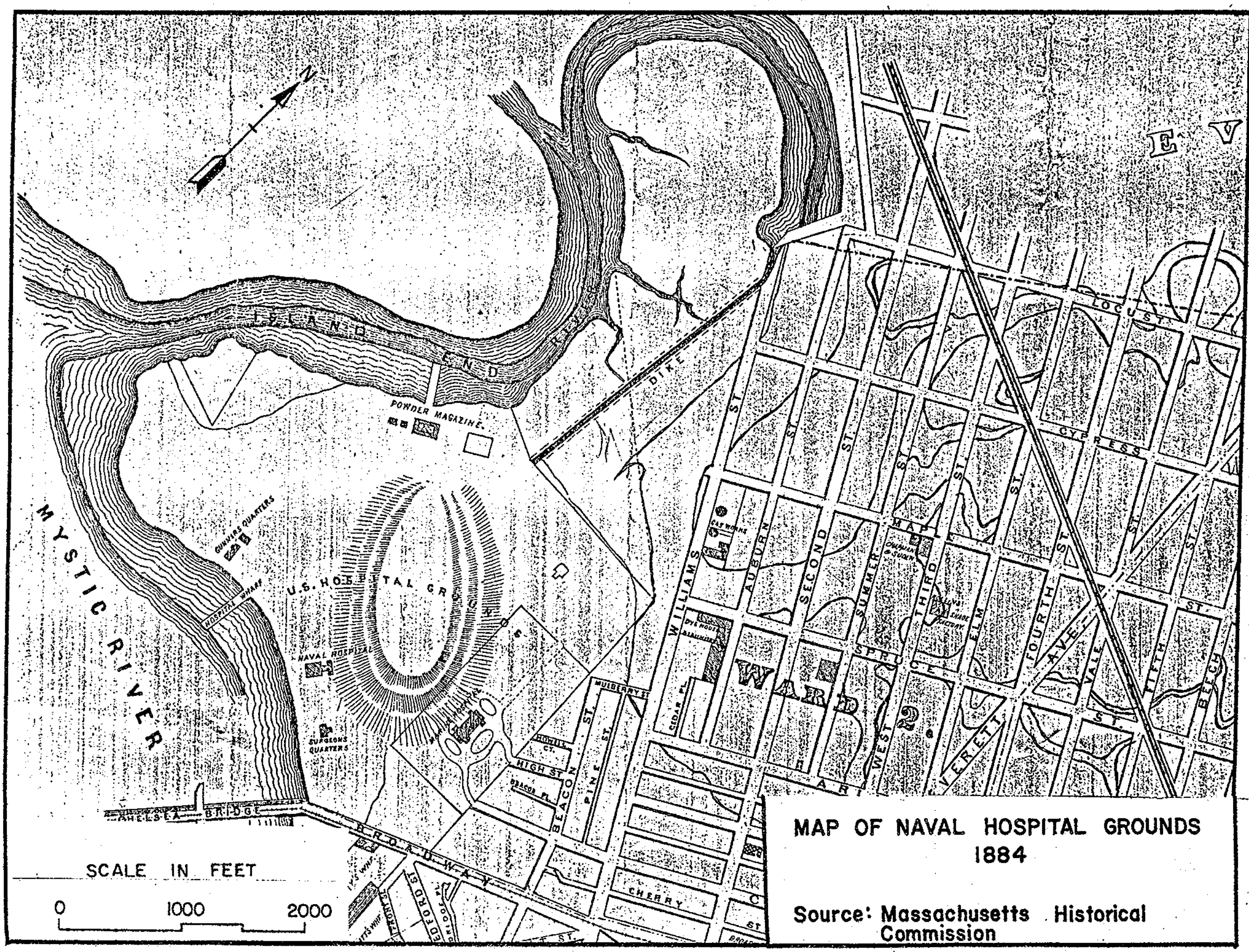
29. Current velocities in the Island End River and the Mystic River are low. Maximum tidal currents are about 1.5 knots. Due to short fetch length, wind wave heights are generally limited to less than two feet on the Mystic River and substantially less on the more sheltered Island End River. The most common wave action results from the wakes of passing vessels.

30. ENVIRONMENTAL SETTING

The Island End River is a tidal estuary approximately three thousand feet long and about four to five hundred feet wide at MHW. At the northern end of the river, the inlet narrows to about one hundred feet in width. Two large corrugated steel arch culverts outfall into the river at the upstream end.

31. The river is generally shallow and the bottom slopes gently to the commercial channel. Dredging has created steep side slopes and an average water depth of twenty-four feet below MLW in the shipping channel along the Everett shoreline. The channel is approximately 1400 feet in length and varies in width from about two hundred fifty feet at its entrance at the Mystic River to about one hundred feet at the northern end. This channel was dredged in the early 1900's to provide access to wharves of the Eastern Gas and Fuel Company in Everett. Maximum surveyed depth in the channel is twenty-nine feet with a controlling depth of twenty-four feet at mean low water. The channel serves barges and freighters frequenting the industries along the Everett shoreline.

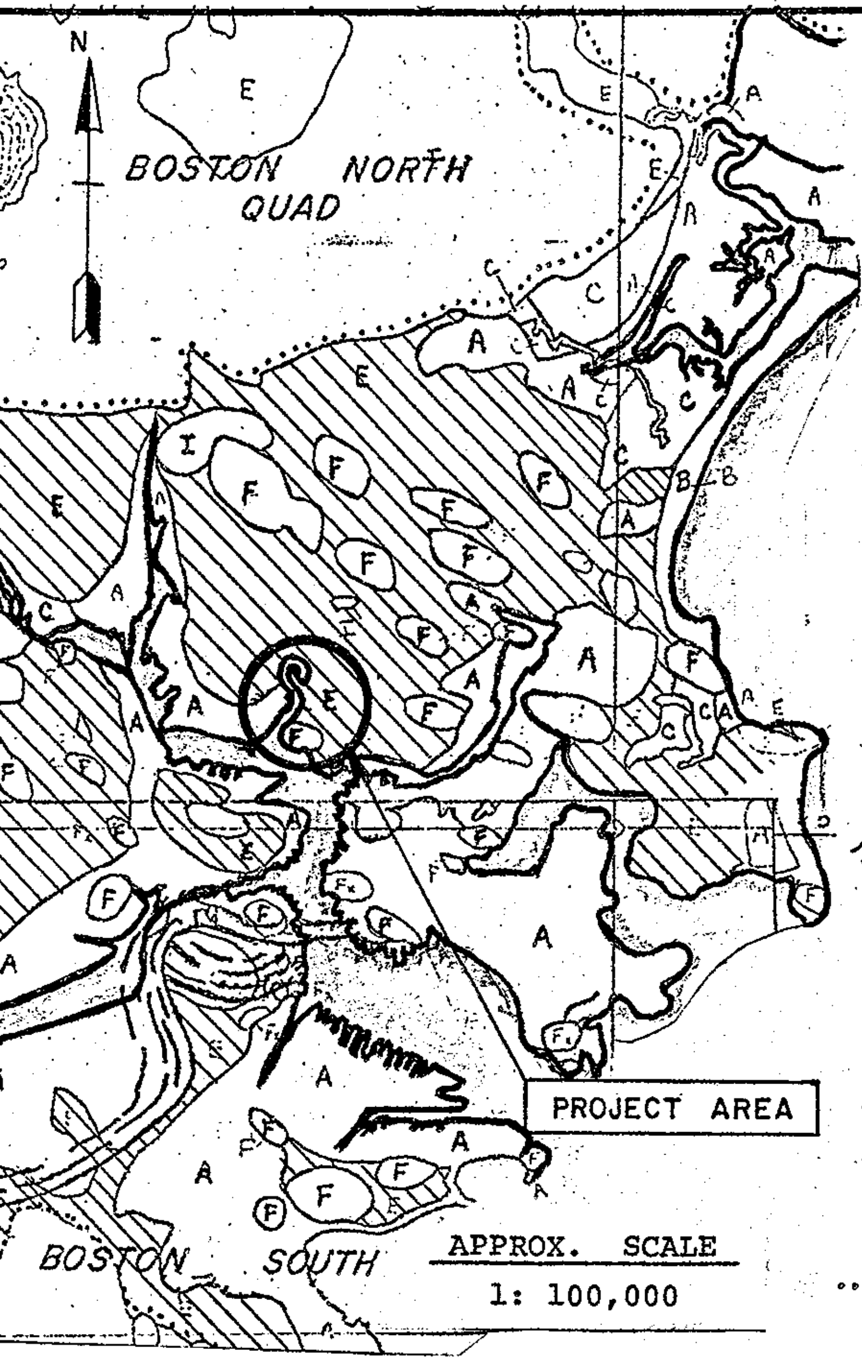
32. To the east and north of the channel, the river bottom ranges from



MAP OF NAVAL HOSPITAL GROUNDS
1884

Source: Massachusetts Historical Commission

FIGURE 1-3



EXPLANA ATION

A MADE LAND - Fill ɢh and sl:e ›ver salt marsh ıallow offshore

B BEACH DEPOSITS -

C SALT MARSH

D ESKER - Sand and ç ɾravel

HOLOCENE

WISCONSIN G LACIATION

E STRATIFIED DRIFT -ı, and :ill; ɛrlain · Sand, gravel, and clay, minor till; in places overlain by swamp

F DRUMLIN - Mostly t :ill
Fx Former ded to provide :rumlins leveled to .land fill

G END MORAINE - Most strati- fied so till ly displaced strati- drift but also till

H GROUND MORAINE - Mome bed- r ostly till, some bed- ock outcrops

I ROCKY TERRAIN - Ma tcrops, thi ft ny bedrock outcrops, n, spotty drift

PLEISTOCENE

••••• Approx. marine limit tocene and early Holocene. S s, mar- ine clays and sands d ified drift particularly at in late Pleistocene eaward of this, mar- ɔminate stratified depth.

HOLOCENE

PLEISTOCENE

CIAL GEOLOGIC MAP OF THE BOSTON AREA, MASSACHUSETTS

URE 1-4

FIGURE 1-4

two to four feet above MLW. At low water the river bottom forms an exposed mud flat. To the north, the mud flat averages 400 feet in width and is divided by a meandering stream about twenty to thirty feet in width and two feet deep. To the east, the bottom rises gently for two hundred feet across the river to the Chelsea shoreline where a steep bank climbs to an elevation of fifteen to twenty feet.

33. The present shoreline of the river generally borders landfill areas. Little marine growth was observed in the intertidal zone. North of the Coldwater Seafood wharves the shoreline consists of deteriorated cargo wharves, timber retaining walls, and banks of fill consisting of rocks and rubble such as broken concrete and bricks.

34. The largely undeveloped eastern shoreline bordering the Naval Hospital site generally consists of a steep bank extending from a mud flat at an elevation of approximately four feet above MLW to a level grassy area at an elevation of fifteen to twenty feet MLW. This bank is retained by a seawall along the first several hundred feet of the Naval Hospital shoreline near the river's mouth. North of the seawall the unprotected bank is eroding and localized areas are undercut between the high water line and the top of the bank. Rocks and large granite blocks have been dumped in the past along the bank in an apparent attempt to stabilize the shoreline in certain places. Refuse such as old tires, paint cans and rotting planks are visible along the shoreline.

35. At about 1500 feet from the mouth of the river, a pier constructed of granite blocks extends about fifty feet into the river. The pier is adjacent to a former magazine building on the Naval Hospital grounds which was used to transfer cargo to ships in the 1800's. At one time, a timber finger pier extended beyond the granite blocks to the middle of the river. Presently, there remains no evidence of the timber pier.

36. The steep bank continues along the eastern shoreline for another five hundred feet. Beyond that is a level marshy area at an elevation just above high water level. This area extends about one hundred feet back from the edge of the river and is thickly covered with saltwater marsh grasses. Other vegetation found along the eastern shoreline includes a number of large willows, sumacs, locusts, poplars and wild cherries.

37. MARINE LIFE

Because the Island End River is polluted, the species found there tend to be pollution tolerant. Near the mouth at the Mystic River, greater volumes of water in the tidal flows provide a cleansing effect. A greater diversity of species is found there.

The bottom sediments in the intertidal zone consist of an upper layer of soft mud up to one and one-half feet in thickness. The mud has a high content of organics and is polluted with high concentrations of heavy metals and petroleum residues. Clamworms, which are pollution tolerant, were found in higher concentrations near the channel in the upper part of the river. Clamworms were also found throughout the intertidal zone in the lower part of the river. Toward the mouth of the river, less tolerant organisms, such as soft-shell clams, blue mussels and barnicles were found in the intertidal zone. These species were not in evidence further upstream.

Birds observed in the river included snowy egrets and herring gulls.

PRESENT NAVIGATION

38. Three industrial firms use the Island End River. The Exxon Corporation presently handles one hundred fifty vessels per year at their berths on the Island End River. These vessels are primarily barges with the capacity of 60,000 to 70,000 barrels and with maximum drafts of seventeen to eighteen feet. The largest barge now using the river has a capacity of 100,000 barrels with a draft of twenty-two feet. Exxon Corporation officials do not predict an increase in the number of vessels using the river, but do anticipate that larger barges will be used in the future. Exxon Corporation officials said that barges up to 150,000 barrels with drafts to thirty feet could be used in the future.

39. Marquette Cement Corporation presently uses a barge approximately three hundred feet in length overall by sixty feet in breadth with twenty-two feet of draft. Marquette receives two or three shipments per month. Coldwater Seafood Corporation has an average of one ship docking per week. The ships are refrigerated freighters ranging in size from 1,000 to 5,000 DWT. The largest is about three hundred seventy feet long with a beam of sixty feet and a draft of twenty-two feet. All of the ships using the Island End River are tug assisted. At the present time, recreational boating use of the Island End River is minimal.

CULTURAL RESOURCES

40. The Chelsea Naval Hospital property constitutes a significant cultural resource is demonstrated by its nomination to the National Register of Historic Places. The land on which the hospital was constructed was the site of early settlement. Records show that the Samuel Maverick Palisades House was fortified against Indian attack in 1625. The hospital site was the terminus of Bay Colony Road (now Broadway), the first county road in Massachusetts. The Hospital property was the landing site of the first ferry service between Chelsea, Charlestown and Boston.

41. The original main hospital building was completed in 1835 at the base of the hill facing the Mystic River. In 1836, land was turned over to the Bureau of Ordinance for construction of an ammunitions magazine. Buildings two and three were constructed as magazines at a location on the western side of the property near the Island End River. Behind these two buildings, a pier was constructed in the Island End River. It is thought that the USS Constitution was among the ships that were stocked from these magazines; hence, buildings two and three have been termined the USS Constitution Magazine. These buildings, along with the original hospital building, the Commandant's House, and the 1859 Marine Hospital constitute the five buildings on the site that are considered to be of special historic significance.

FUTURE CONDITIONS WITHOUT THE FEDERAL PROJECT

42. Five possible scenarios were considered to represent the future conditions in the Island End River if the federal project is not undertaken. All of the scenarios take the following three conditions as given:

The three existing industries presently using the Island End River for shipping will continue to do so in the future. They are well established and continued use of the river is essential for their operation.

The Metropolitan District Commission park will be constructed as planned. Acquisition of the property by the MDC is pending.

The Chelsea Naval Hospital property will be developed for housing and other uses as currently planned.

ALTERNATIVE FUTURES

43. The following five scenarios represent possible futures that might occur if the federal project is not undertaken.

44. SCENARIO 1

Future industrial development requiring water access would occur on the Everett shoreline upstream of the Coldwater Seafood Corporation. This would require extension and expansion of the existing commercial channel. Development of the marina would not occur as planned on the Chelsea side of the river.

45. SCENARIO 2

The City of Chelsea and private developers would undertake dredging of a recreational channel without federal funds. Under this scenario, the project would proceed as planned with a mixture of private and local government funding. No expansion of commercial shipping would occur in the river.

46. SCENARIO 3

Without the federal project, marina plans would be abandoned and the proposed marina site would be considered for industrial uses. An industrial zone would extend from the existing Polaroid building to the northern edge of the proposed MDC park. Under this scenario, no dredging of the river would occur. Recreational use of the river would be extremely limited.

47. SCENARIO 4

Without the federal project, marina plans would be abandoned and the marina site would be used for industrial purposes. The demand for mooring space for recreational craft would result in the construction of a limited amount of mooring facilities along the Everett shoreline, north of the Coldwater Seafood Corporation. Sufficient depth presently exists there for a distance of about three hundred fifty feet upstream. Approximately thirty recreational boats could be moored there. No dredging of the river would occur.

48. SCENARIO 5

Under this scenario, the marina plans would be abandoned and no mooring facilities would be constructed on the Everett side. The proposed marina site would either be left undeveloped or incorporated into the proposed MDC park. No dredging or filling of the river would occur.

EVALUATION

49. Future expansion of industries requiring water access, as in Scenario 1, appears to be relatively unlikely. The Everett shoreline is fully developed and there is no undeveloped land available. The existing industries upstream of the channel have no need for water access and the existing wharves already are deteriorating.

50. Dredging of the channel without federal funding as in Scenario 2 is unlikely due to the substantial cost of the project and the fact that the City is relatively poor and has a limited tax base. Although the project would eventually serve to increase the tax base, the City would probably be unable to provide sufficient funds for the initial capital improvements.

51. Extensive industrial development along the Island End River as set forth in Scenario 3 would not be compatible with the historical Constitution Magazine structure, the proposed MDC park or the adjacent upper income housing.

52. Scenario 4 assumes that property owners on the Everett shoreline would be willing to commit a portion of their land to the shore-related marina facilities such as parking lots. Although it appears possible that mooring space could be provided in the river along the Everett side without dredging, provision of land access would be difficult. A rail spur running along the shoreline between the Exxon Corporation terminal and the Boston Fruit Auction is in active use. Provisions for parking and pedestrian access would be difficult due to the existing land use pattern in the area.

MOST PROBABLE FUTURE

53. Scenario 5 is considered to be the most probable future if the federal project is not undertaken. Conditions in the Island End River would remain essentially the same as they are today. Probably no major dredging, filling or alterations of the shoreline would probably occur.

54. Plans for redevelopment of the Chelsea Naval Hospital would be adversely affected if improvements to the Island End River are not implemented. Some 1500 unites of luxury housing are proposed for the Naval Hosptial site. Some of these units will be oriented to view the proposed

marina. The presence of an onsite marina is also considered to be an added amentity for prospective occupants. There would therefore be some reduction in the marketability of the housing if the proposed marina facilities are not constructed. The restoration of Buildings two and three would probably be limited. Public, rather than private, funds would probably be required as there would be limited incentive for private investment.

55. Development of the MDC park would occur as planned if the Federal improvements to the river did not take place. However, the potentially synergistic effects arising from the proximity of the public open space to the recreational boating facilities would not occur.

56. With visual access to the shoreline of the Island End River along the MDC park property and with the presence of a residential population on the former hospital grounds, it is likely that there would be some public pressure to clean up the river.

57. Water quality in the river could be expected to improve gradually in the future as measures to clean up the Mystic River and Boston Harbor are implemented. Species such as clams and mussels might slowly reestablish themselves in upstream portions of the Island End River, although the river would remain closed for shellfishing for the foreseeable future.

58. Recreational boating in the Island End River is expected to remain limited in the future. Occasional transient craft may enter the lower portions of the river at interim and high tidal conditions. A few boats might be moored offshore and allowed to ground at low tides. While this type of mooring arrangement has been observed in other parts of the Boston area, the restrictions placed on boat usage by tidal fluctuations make this arrangement unacceptible to most small craft owners.

PROBLEMS AND NEEDS OF THE STUDY AREA

59. The problems and needs of the study area were identified through consideration of baseline conditions, development proposals for the Island End River and Chelsea Naval Hospital site and the concerns of agencies and interested parties.

THE PROBLEM OF A LIMITED TAX BASE AND EMPLOYMENT OPPORTUNITIES

60. The City of Chelsea is relatively poor and geographically small. The tax base still suffers from the effects of a devastating fire in 1973 that destroyed forty-five acres of industrial and residential property. The tax base could be greatly expanded by private redevelopment of the now tax exempt Naval Hospital site. The marina is considered an important part of the redevelopment effort. It will generate tax revenue itself, will enhance the marketability of the housing and will encourage development of marina-related enterprises such as restaurants, nautical supply stores, boat sales and repairs. The federal project is considered vital to the successful development of the marina.

61. Because of their desire to create a compatible environment for the redevelopment of the Naval Hospital site, the City is also concerned with the aesthetic quality of the river. They would like to see an extensive dredging effort to remove the majority of the exposed tidal mud flat areas. They consider a more extensive open water area at low tide to be more visually attractive and they are concerned about potential odor problems form the exposed mud flats at low tide.

THE PROBLEM OF LIMITED RECREATIONAL FACILITIES AND WATERFRONT ACCESS FOR CHELSEA RESIDENTS

62. Chelsea, with a population of about 25,000, has only twenty-five acres of recreation space. According to the National Park and Recreation Association and the U.S. Department of Interior Standards, there should be one acre of open space for every one hundred residents, or approximately two hundred fifty acres in the City of Chelsea.

63. In addition to the shortage of open space and recreational facilities, Chelsea residents have virtually no public access to the waterfront. Although the city is abutted on three sides by water, extensive development of the shoreline for industrial purposes limits its accessibility.

THE PROBLEM OF INADEQUATE BOAT MOORING SPACE, BOAT REPAIR AND STORAGE FACILITIES IN BOSTON HARBOR

64. The greater Boston area suffers from a shortage of recreational slips due to the great demand for recreational boating and a limited supply of suitable marina facilities. Development of marinas is limited by a lack of available undeveloped shoreline areas next to sheltered waters and by environmental factors.

65. Some residents of the Boston area must travel great distances to a marina where they keep their boat. Others keep their boats on open moorings in unsheltered locations. Discussions with marina operators indicated that some have waiting lists of up to five years for space and have stopped taking applications.

66. According to the Master Plan there is also a shortage of boat repair and storage facilities for boats within the Boston Harbor area. Although there are several marinas in the harbor, shore facilities are apparently not so readily available as in suburban locations where land is more available.

THE PROBLEM OF RESTRICTED NAVIGATION

67. Because of the shallow depths in the upper reaches of the Island End River, navigation cannot occur in much of the river during low tide and much of the ebb and flow period. Any proposed channel improvements must provide sufficient space so that all maneuvering can be accomplished within the channel limits.

PROBLEMS OF NAVIGATION

68. Many operators of small craft have limited experience in operation and navigation. Therefore, relatively straight channel alignments are desirable.

THE PROBLEM OF CONFLICTS WITH EXISTING SHIPPING

69. Present shipping activities are likely to continue in the Island End River for the foreseeable future. Due to the restricted dimensions of the existing channel and the restricted maneuvering capabilities of large vessels under tow, conflicts between existing shipping and future recreational boating may develop. This potential problem would be most noticable if recreational craft were required to use the existing commercial channel.

THE PROBLEM OF SECURITY AT THE EXXON TERMINAL

70. Discussions with government agencies and the industrial concerns located along the westerly shore of the Island End River in Everett served to identify potential problems associated with use of the river by recreational craft. In general, representatives of the industries which use the Island End River felt that small craft in the river would cause little interference with operations. Some concern was expressed about accidents if small boats are to use the existing channel. Enforcement of boating safety regulations would help alleviate potential problems. They noted that commercial shipping already mixes with recreational boating on the Mystic River, although substantially more space is available for maneuvering.

71. Representatives of Exxon were more concerned with the potential for an accident with the volatile chemicals, such as gasoline or naptha handled at their terminal. They preferred that the recreational channel be situated at a reasonable distance from their terminal.

THE PROBLEM OF POOR WATER QUALITY

72. At present, water quality in the Island End River is poor. Bottom sediments in the river are polluted with heavy metals and petroleum residues, due to runoff from urban areas, leaching from solid wastes disposed of near the shore of the river and possible discharges from vessels and industrial activities on the shoreline of the river. The proposed project could impact water quality in several ways. In the short term, dredging will result in deterioration of water quality. However, it will also remove a portion of the polluted bottom sediments. Long term impacts of the project will be due to pollution produced by the recreational boats.

PROBLEMS WITH DISPOSAL OF DREDGED MATERIAL

73. Sediments in the Island End River are primarily organic silts and clays and are contaminated with heavy metals and petroleum products. If these materials were removed by dredging, both state and federal regulations would control their disposal.

74. Ocean disposal of dredged material is controlled by federal regulations. Because the sediment has passed minimum federal bio-assay standards for toxicity to marine organisms, ocean disposal will be permitted. However, adverse impacts on water quality and marine organisms will be associated with the discharge of any type of sediment into the ocean.

75. Under state regulations, land disposal of dredge material must take place in a site which is approved by the local board of health, and is con-

fined in diked or bulkheaded sites with facilities to control effluents. Because of the presence of pollutants, the Massachusetts Department of Environmental Quality Engineering felt that land disposal of the dredged material from the Island End River could be a serious problem. In addition to its toxic properties, the sediment has poor structural properties. Therefore, the dredged material would not be usable as a structural fill material beneath buildings or structures. Disposal at the site of the proposed landfill at the proposed Massport Containers Port facility in South Boston is feasible. However, the schedules of the two projects would have to be coordinated and the dredged materials would have to be similar to the other materials to be involved in the landfill.

PROBLEMS WITH ALTERATION OF THE INTERTIDAL ZONE

76. The National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries expressed concern over preservation of the intertidal zone. Because the extent of the intertidal zone habitat is limited in the inner Harbor, efforts should be expended to preserve remaining areas. Marine life in this zone serves as a food source for fin fish. The agencies felt that it may become a more important resource in the long term as water pollution is abated. Soft-shell clams were found in the intertidal zone near the mouth of the river. Although the Island End River is closed to shellfishing because of pollution, the existing shellfish population can help to repopulate other shellfish beds in Boston Harbor.

OPPORTUNITIES

77. The former Naval Hospital site presents an opportunity for the City of Chelsea to develop the property for a variety of civilian uses. The hospital site can be considered a unique land resource in that it provides eighty-eight acres of developable land on a scenic site only two miles from downtown Boston. Its undeveloped waterfront has a potential for recreational use in an area where most of the waterfront is used for industrial purposes. The availability of a marina site also presents an opportunity to address regional needs for boat mooring and storage facilities, public access to the waterfront, and public recreation facilities.

SECTION B
PLANNING OBJECTIVES AND CONSTRAINTS

NATIONAL OBJECTIVES

78. Planning for channel improvements in the Island End River is based in part on national objectives of economic development and enhancement of environmental quality. Section 103 of the Water Resources Planning Act of 1965 directed the National Water Resources Council to establish principles and standards for planning federal and federally-aided water resource projects. In 1973, the Council published Principles and Standards for Plann-ing Water and Related Land Resources which provide the broad policy framework for planning activities. The Standards provide for uniformity and consistency in comparing, measuring and judging the beneficial and adverse effects of alternative water resource improvement projects. The purpose of the Principles and Standards is to promote the quality of life by planning for the attainment of the following objectives:

> To enhance national economic development by increasing the value of the nation's output of goods and services and improving national economic efficiency.
>
> To enhance the quality of the environment by the mangement, conservation, preservation, creation, restoration, or improvement of the quality of certain natural resources, cultural resources and ecological systems.

79. These are generally termed National Economic Development (NED) and Environmental Quality (EQ) objectives. The NED and EQ objectives were fully considered in developing and evaluating the alternative improvement plans.

PLANNING OBJECTIVES

80. Planning objectives are based on consideration of the national objectives of economic development and environmental quality, and the specific problems and needs of the project area. The planning objectives are used in the development and the evaluation of alternative plans. In some cases, the following planning objectives may represent valid but conflicting goals. The final plan will incorporate trade-offs among different objectives.

81. COORDINATION WITH THE CHELSEA NAVAL HOSPITAL MASTER PLAN - Alleviate the problems of a limited tax base and restricted employment opportunities through encouraging full scale development of the Chelsea Naval Hospital site in conformance with the site Master Plan by constructing the recommended 250 boat marina facilities on the Island End River. Marina-related commercial use is proposed for Buildings two and three. The existing pier will be used as part of the marina. The plan also calls for a commercial/industrial site adjacent to the marina.

82. COORDINATION WITH THE PROPOSED MDC PARK - Improve the problems of limited recreational facilities and waterfront access for Chelsea

residents by encouraging development of the proposed MDC park. The channel improvement plans should be compatible with the concept of a waterfront park along the shores of the Island End and Mystic Rivers. An important consideration is the need for protection of the park's shoreline.

COORDINATION WITH THE PROPOSED MARINA FACILITIES

83. Help alleviate the problem of inadequate boat mooring space, repair and storage facilities by encouraging development of the proposed marina facilities. The channel improvement plans must take into account the proposed location of the marina and boat launching ramp, the effects of shoreline protection on proposed adjacent land uses and the effects of land disposal of dredged material on proposed land uses. The channel and turning basin will be located to accomplish the following:

provide sheltered dock areas;
minimize costs of marina development;
provide for maximum number of spaces at the marina and
allow for flexible staged construction of the marina.

84. To date, detailed marina plans have not been developed by the City of Chelsea. Therefore, the channel locations developed in this study may place restrictions on the location and configuration of subsequent marina development. The costs of the marina development will be borne by the local government and private developers. The channel locations must allow for the marina development at a reasonable cost and must provide for as large a capacity as is economically feasible, since future revenues will be based on rental of marina slips. Recreation benefits are also dependent upon the number of boats which will use the proposed marina.

PROVIDE SAFETY AND MANEUVERABILITY IN THE PROPOSED CHANNEL

85. Due to the existing restrictions on navigation in the Island End River, adequate channel width and depth should be provided for the types of boats expected to utilize the channel. The channel dimensions should allow for safe operations with minimum possibilities of collisions or groundings. The Reconnaissance Report recommended channel dimensions of one hundred feet wide and six feet deep. The required dimensions will be established by evaluating the requirements of the projected fleet.

PROVIDE A STRAIGHT CHANNEL TO AID IN NAVIGATION

86. Due to the anticipated inexperience of many boat operators in the Island End River, a relatively straight channel alignment should be provided to simplify navigation for small craft.

PLANNING CONSTRAINTS

MINIMIZE CONFLICTS WITH COMMERCIAL SHIPPING

87. Conflicts with industrial shipping should be minimized both to avoid delays and to reduce potential safety problems. Some interference and delays are likely, especially at low tide if the existing commercial channel is used by small boats. Of greater concern are the safety problems associated with the

maneuvering of tug assisted barges and freighters in a confined channel. Tug propeller wash is strongly turbulent and is capable of overturning small craft. Methods, procedures and schedules of proposed dredging operations must be controlled to prevent disruption of commercial shipping during construction.

DISCOURAGE RECREATIONAL BOAT USAGE IN THE VICINITY OF THE EXXON TERMINAL

88. Due to the possibility of an accident involving the volatile chemicals at the Exxon Corporation the proposed recreational channel should be located at a reasonable distance from the existing commercial channel at the Exxon facilities.

MINIMIZE THE AMOUNT OF DREDGING

89. The total volume of dredge material should be carefully controlled to minimize economic costs and adverse environmental impacts. Dredging will cause primary adverse effects on water quality, marine life, and the intertidal zone and secondary adverse impacts relating to the disposal of dredged materials. During the dredging, short term impacts occur as bottom sediments are stirred up and remain in suspension in the water. Dredging operations also contribute to air pollution and noise. A longer term effect is due to alteration or destruction of marine life that inhabits the intertidal zone. It is also desirable to reduce the amount of dredging in order to diminish the problems associated with disposal of the dredged material.

AVOID ENCROACHMENT ON THE MDC PARK

90. The MDC has begun the development of a twenty-six acre park along the edges of the Mystic and Island End Rivers. Since locating the marina within the proposed park would directly conflict with current park plans, the marina facility must be located upstream on the Island End River.

91. The marina would require that a substantial amount of land area be devoted to facilities such as parking, access roads, and structures. There is a limitation on land available at the site of the proposed park for such facilities. Further, it is contrary to MDC policy to supply such facilities on park property for non-park users.

AVOID ALTERATION OF THE EVERETT SHORELINE

92. The entire Everett shoreline is highly developed and is protected by timber bulkheads or riprap. Most of the land up to the bulkheads or top of slopes is in active use. Any changes to the Everett shoreline would likely require acquisition of property and would probably meet opposition from Everett property owners. In order to preserve the stability of the slopes on the Everett shoreline, channel alignments must be placed at an appropriate distance from the Everett side. The criteria for locating channel alternatives are discussed in Appendix 4. No marina facilities should be located on the Everett shore as there is insufficient land available for suitable support facilities.

EXHIBIT 1-1

Development Plans Chelsea Naval Hospital

The following is a series of excerpts from the Development Master Plan and Feasibility Analysis - Chelsea Naval Hospital. These excerpts provide an overview of the development plans for the marina.

SUMMARY OF THE PROPOSED DEVELOPMENT PLAN

The program of development for the Hospital site includes the following elements:

- o Waterside Public Park of 26 Acres.

- o Residential Community of 1200 units including approximately:

  300 Duplex Townhouses
  570 Mid-Rise Market Rate Apartments
  300 Subsidized Elderly Apartments

- o Marina for 250 Boats and Related Marine Commercial Uses.

- o Fourteen Acres of Light Industrial Uses.

The Waterside Park is planned as a passive recreation area where residents from Chelsea and surrounding cities can picnic, play, and enjoy the views of harbor activity. The heavily landscaped park will be operated by the MDC and be open to the public. Though larger in size, it's use will be similar to the waterfront park in Boston.

The residential community, atop the hill to afford striking views of the Boston skyline, the harbor, and the outer suburbs to the north, is planned at a relatively low density to improve it's marketability. The duplex townhouses will be built into the side of the hill affording ease of entry and privacy. The mid-rise, conventionally financed, apartments will include both new construction and the rehabilitation of historic structures. Ancillary commercial and community facilities will be located on the first floor and courtyard of the historic Marine hospital. This Town Centre will be the focal point for community activities, including tennis, swimming, meeting rooms and a health club. The elderly apartments will also be adjacent to this activity area.

The Island End River will be dredged to provide one of the few protected marinas for small boats in Boston Harbor. Townhouses will be constructed near the piers with boat storage and related marine commercial uses developed on the low land adjacent to the marina.

The plan also calls for other light industrial uses to be built on the flat land on the eastern side of the new access road connecting the site with newly reconstructed Spruce Street.

As indicated by an analysis of the Greater Boston housing market the apartments and townhouses should receive strong market acceptance because of the proximity of the site to downtown Boston and the views and amenities inherent in the proposed plan. Achievement of the development program is depenant, however, upon the availability of public funding for site clearance, roadway and utility construction, and a subsidy to defray the excessive costs of rehabilitating the historic structures for residential uses.

In the next stage of implementation the site will be advertised for developers, environmental clearances obtained, and final acquisition negotations with GSA completed. Preliminary indications of support for federal funding have been obtained, thus it is anticipated that the required BOR, EDA, and HUD grants will be received in the first half of the 1978 with actual demolition and construction commencing in 1979.

DEVELOPMENT IMPACT ON THE CITY OF CHELSEA

Hopes for the rebirth of Chelsea rest with the accomplishment of this development program. When completed the project will produce over $1,000,000 per year in taxes on land previously tax exempt. This revenue, amounting to approximately $18/1000 on the Chelsea tax rate, will afford the City an opportunity to better provide sorely needed services to its below average income population.
Most importantly, however, the park, marina, and housing will signal to all that Chelsea has been reborn, that it can attract upper-income people back to the city, that it is not merely a declining industrial city. The impact of that change in preception will have far-reaching effects on the surrounding property throughout the city.

CHAPTER 3

HOUSING DEVELOPMENT PLAN

GENERAL DESCRIPTION

This Housing Development Plan is intended as a set of guidelines and constraints for the private development of those areas of the Chelsea Naval Hospital site not included in the proposed MDC Park and the marina development area. The Plan defines the range of feasible and desirable potential uses which a private developer or developers will be permitted to construct on the site, and describes the environmental goals that the design of the constructed units should attempt to achieve.

The Development Plan (see Exhibit 3-1) divides the private development portion of the site into Development Zones, and for each defines the types and numbers of units, heights of construction, environmental characteristics and amenities recommended for that zone. These zones should be understood as general areas of the site, as their defining characteristics will suggest, and not as parcels with rigid boundaries boundaries. Furthermore, the unit types and characteristics recommended for each zone are not intended as unquestionable restrictions; rather, some mixture and variation upon the guidelines may be appropriate. The Development Plan is designed to permit a range of solutions, setting only the predominant character for the development of each area of the site.

The description of the Development Plan is accompanied by an Illustrative Site Plan (Exhibit 3-2) and companion photographs of a site model (Exhibit 3-3). These designs illustrate one potential solution that typifies and complies with the Housing Development Plan guidelines. This is not intended to suggest that the design is the only acceptable solution; rather, this Illustrative Site Plan should assist the reader in understanding and imagining the reasons for and implications of the Development Plan guidelines.

Overall Character

The design approach to the site should attempt to utilize and preserve the natural assets of the site - its visible hilltop, slopes and well-developed vegetation. The image of the whole site that the veiwer approaching on the Mystic River Bridge has should be that of the dominance of the topographic features and vegetation, rather than of the buildings placed upon the site.

Development is projected of approximately 1200 units of housing on the site, to be developed in stages as described below (see Phasing Proposal). Of that total, roughly 25% - 30% should be townhouse units, 45% - 50% market-rate apartments, and 20% - 25% subsidized apartments for the elderly.

The housing development should take advantage of and orient to, as much as possible, the attractive views and desirable micro-climate toward the south, southwest and west. The buildings atop the hill should act as a buffer from the harsh winter winds from the north; they should capitalize on the attractive long distance vista of the hills to the north and northeast, while screening the views of the nearby industrial area.

The housing development should be designed to give a sense of neighborhoods within the overall development, through clustering of units and focal community spaces. The residents should be able to identify with a smaller neighborhood grouping, rather than only the overall 1200-unit development.

Certain existing structures on the site are to remain in the new development: those that are on the National Historic Register, including buildings one, fifty-nine, the Commandant's House and the Constitution Magazine; and some which are substantial residential structures that can be easily reused for residences and which add continuity to the historic characrer of parts of the site, including residence B,C,D,E,F, and G. These buildings should be actively reused and integrated into the overall development and use of the site. Others may desire to rehabilitate additional structures which is to be encouraged.

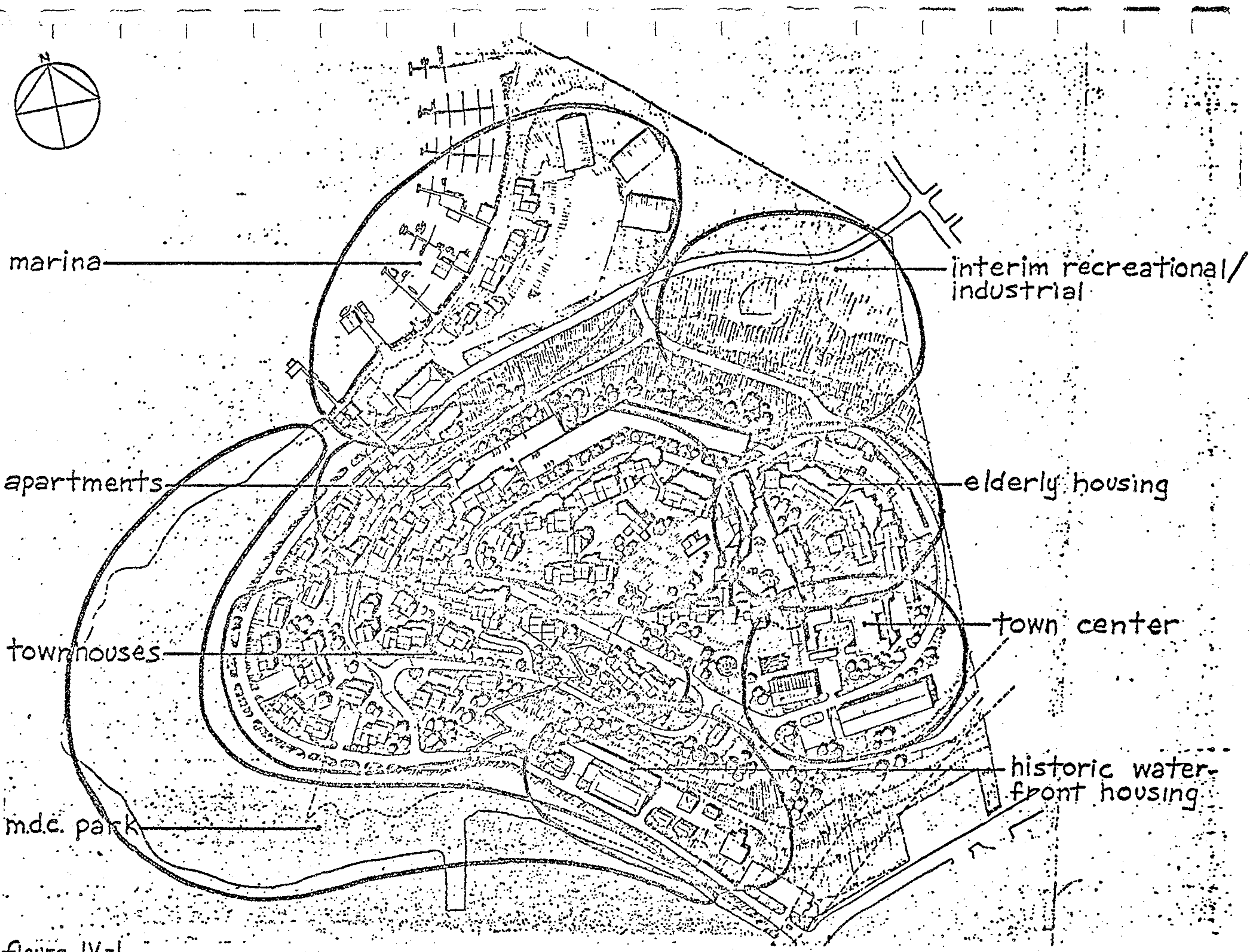


figure IV-1
Development Plan - Chelsea Naval Hospital Site

CHAPTER 5

COMMERCIAL-INDUSTRIAL DEVELOPMENT AREA

GENERAL DESCRIPTION

The redevelopment program of the Chelsea Naval Hospital site calls for one-fouth (1/4) or approximately 22 acres to be developed for commercial or industrial purposes. The area designated is the relatively flat section of the site adjacent to the Murray Industrial Park. The new access road will link this section directly to Spruce Street.

The major focus of this commercial-industrial development area will be a new marina for approximately 250 boats on the Island End River. In addition to the marina itself with ancillary commercial facilities such as a restaurant the development program calls for marine related industrial uses such as boat repair and storage. Light industrial uses not marine related are also possible on the site.

A substantial need for pleasure boat docking facilities exists in Boston Harbor. With the increase in boating activities there are long waiting lists for docking space at protected marinas. The proposed marina area though requiring substantial site improvements is particularly well suited for this use. Removed from the main shipping channel the mooring area will be protected from the wave action of passing tugs and ships. The proposed marina will afford boat owners easy access to the open ocean and yet protection from storms.

The large marina as proposed will create a requirement for the ancillary boat repair and storage services. In addition, these services are not readily available in the inner harbor, so it is anticipated that boats moored elsewhere will be brought to the proposed facility for repair and storage. Eventually it is hoped that marine related manufacturing facilities might also be developed on the site. The land not used for marine facilities is available for general industrial development. Sweetheart Paper Company, an abutter to the site, is interested in acquiring a portion of the land for its expansion needs. It is also anticipated that when the Murray Renewal Park is completely sold that there will be additional demand for industrial land. The physical improvements to the renewal area are now being completed so sales of that land should begin in the next six-months. One half of the site has been sold as a shopping center site which is now under-construction. The industrial land in the Naval Hospital site will be ready for marketing in approximately two years when the access road is constructed. This time schedule will mesh with the completion of marketing activities in the renewal area.

SITE IMPROVEMENT COSTS

In addition to the new access road connecting the site to Spruce Street which is also required for the park and housing developments, substantial site improvements will be required to create a marina in the Island End River. Historically marina development without some form of public subsidy has been difficult. It is especially so on this site where a harbor itself must be created. In general the public sector will create the waterfront facilities and piers and the operator of the facility will construct the buildings on the approximately 8 acres of land. Some subsidy will also be required to offset the excessive costs of rehabilitating the Constitution Magazine. An estimate of the development costs prepared by Sasaki Associates based on similar marina design is set forth below for the marina facilities. The figures do not include the potential private development of the remaining 14 acres of industrial land. It is proposed that the facility would be constructed with public funds and leased for a long term to the private developer. The lease would guarantee the availability of berthing space on an equitable basis. Tax revenue from the commercial-industrial area should approximate $300,000 per year based on a 50% load coverage for industrial and 20% of gross marina revenues.

MARINA DEVELOPMENT

PRELIMINARY COST ESTIMATE

PUBLIC DEVELOPMENT COSTS

Dredging	$ 500,000
Floats	367,200
Piers	165,000
Bulkhead	550,000
Concrete Slab & Cap	63,500
Rip Rap	13,440
Extra Structural Repair of Bldg. 3	120,000
Sub Total	$1,779,140
Contingency, Engineering & Escalation 30%	533,742
Total Public Development Cost	$2,312,882

PRIVATE DEVELOPMENT COSTS

Plaza	562,000
Asphalt Paving	357,094
Structures	2,400,000
Renovation	372,750
Concrete Walk	9,300
Landscaping	18,450
Sub Total	$3,719,594
Contingency, Engineering & Escalation 30%	1,115,878
Total Private Development Cost	$4,835,472

FUNDING PROGRAM
(000)

	Total Cost	BOR	EDA	Corps Eng.	HUD UDAG	Comm. of Mass.
PUBLIC COSTS						
PARK						
Demolition	$ 103.8		62.3		41.5	
Construction	2,255.9	1,128.0				1,127.9
Sub-Total	2,359.7					
HOUSING & OTHER						
Demolition	924.2		554.5		369.7	
Roadways	1,070.0		128.4		941.6	
Sewer	365.0		54.8		310.2	
Storm Drains	564.8		84.7		480.1	
Water	796.5		119.5		677.0	
Electrical	410.0		61.5		348.5	
Restoration	360.0				360.0	
Land Purchase	746.0				746.0	
Contingencies/Engineering	826.1		123.9		702.2	
Sub-Total	6,062.6					
COMMERCIAL-INDUSTRIAL						
Dredging	500.0			250.0	250.0	
Piers & Bulkhead	1,159.1		695.5		463.6	
Restoration	120.0				120.0	
Contingencies/Engineering	533.7		320.2		213.5	
Land Purchase	622.6				622.6	
Sub-Total	2,935.4					
ADMINISTRATION & LEGAL	500.0				500.0	
ADJACENT ROAD IMPROVEMENTS	2,300.0					2,300.0
Sewer & Water	372.0		223.2		148.8	
Less Land Proceeds	(1,368.6)				(1,368.6)	
TOTAL PUBLIC COST	$13,161.1	1,128.0	2,428.5	250.0	$5,926.7	3,427.9
PRIVATE COSTS						
Housing	53,528.7					
Marina	4,835.5					
Industrial	10,323.7					
TOTAL PRIVATE COSTS	$67,687.9					
TOTAL INVESTMENT	$81,849.0					
RATIO PUBLIC TO PRIVATE	6.2:1					

APPENDIX 2

FORMULATION, ASSESSMENT AND EVALUATION OF DETAILED PLANS

SECTION A

FORMULATION, ASSESSMENT AND EVALUATION OF DETAILED PLANS

1. The formulation of a plan of improvements for the Island End River has followed the procedures of the Water Resources Council Principles and Standards. Local needs and objectives were identified and project-specific planning objectives and constraints were established. These planning objectives and constraints were considered in the formulation of detailed plans, as were the national objectives of National Economic Development (NED) and Environmental Quality (EQ).

FORMULATION AND EVALUATION CRITERIA

2. Detailed technical, economic and environmental criteria were applied in the formulation and evaluation of the alternative plans. These criteria reflect quantitative measures of the plan performance in relation to the national and local planning objectives and planning constraints. These criteria, which are described below, are utilized in the System of Accounts to evaluate the four alternative detailed plans.

TECHNICAL CRITERIA

3. The technical criteria are as follows:

- The selected plan should allow adequate space for a marina with a capacity of about two hundred fifty slips. The marina should be located such that the shore facilities can be provided at a reasonable cost and in a manner consistent with the overall redevelopment plans for the Naval Hospital property.

- Channel dimensions (length, width and depth) should be adequate for the types of craft expected to use the river.

- Provide adequate separation from the Everett shoreline such that dredging will not have an impact on the stability of the shore and no shore protection will be required.

ECONOMIC CRITERIA

4. The economic criteria are as follows:

- Maximize net benefits (project benefits minus project costs).
- Minimize local cost of the project.

- Maximize net benefits to the City of Chelsea (sponsor of local share of project cost).
- Minimize potential development cost of locally funded harbor improvements, such as the boat launching ramp and marina.
- Minimize adverse impacts on operations of existing industries in Everett.

ENVIRONMENTAL, SOCIAL AND CULTURAL CRITERIA

5. The environmental, social and cultural criteria are as follows:

- Minimize volume of dredge material in order to reduce problems relating to the disposal of dredged materials.
- Minimize removal and alteration of intertidal areas to avoid impacts
- Provide aesthetic compatibility with MDC park and Naval Hospital housing redevelopment plans.
- Enhance and restore historic character of U.S.S. Constitution Magazine and pier.
- Maximize safety and ease of navigation to recreational craft.

SECTION B

POSSIBLE SOLUTIONS

6. Possible solutions to the problem of developing recreational boating facilities at the Chelsea Naval Hospital property include utilizing existing conditions (no improvement option) or developing new facilities.

NO IMPROVEMENT OPTION

7. The development of recreational boating at the Naval Hospital property without the federal project would be extremely unlikely. With no federal project there would be essentially two options that could be undertaken without dredging.

8. The first would be to make use of the Island End River in its present condition for the mooring of boats. Because of the tidal range and the present depths in the river, moored boats would have to be allowed to ground at low tide. The types of boats used would, therefore, be limited to small outboards or small centerboard sailboats. Use of the river would be limited by tide conditions.

9. The other possibility under the no improvement option would be to locate a marina along the Mystic River where adequate depths are already available.

10. Although the depth of the water at a Mystic River site would be adequate and would require little dredging, there are other disadvantages. A marina site on the Mystic River is not as sheltered as the Island End River. Boats would be exposed to waves in the river as well as wakes from passing ships. The number of berths in a marina would be constrained by the amount of space available between the shoreline and the pier/bulkhead line which is quite close to shore. Because of the heavy use of the Mystic River by commercial shipping, it is unlikely that a marina would be allowed to extend beyond the pier/bulkhead line. The pier/bulkhead line is also close to the shore along the Island End River; however, because there is currently no vessel traffic at the proposed marina site, it is anticipated that the restriction of the pier/bulkhead line can be relaxed. Even if the pier/bulkhead line restriction did not apply on the Mystic River, there would be sufficient space for marina development there than in the Island End River. There is a second primary factor, however, which precludes development of the marina on the Mystic River. It is the intended use of the shore as a park.

11. There would be a number of legal and jurisdictional problems involved with locating the marina off the shore of the proposed MDC park. The City of Chelsea would like the marina to be operated by private industry on a long-term lease and thus produce revenue for the City. Current MDC policies prohibit the providing of facilities for private use with public funds. Facilities in MDC parks are generally only provided for the users of the

park. In addition, the need to provide security for the marina is generally incompatible with the open access of the park. Substantial space would be needed on shore for parking and marina support facilities. Most of the land within the park has been allocated for various recreational uses. The marina is also intended to stimulate other tax-revenue producing private development on shore such as restaurants or marina-related enterprises. Neither marina support facilities nor related on shore private development is compatible with the aesthetic quality or function of a park. Therefore, location of a marina and related shore facilities within the limits of a publicly owned MDC park is incompatible with the plans for and the intended function of the area.

DEVELOP NEW FACILITIES

12. The development of new facilities in the Island End Rver is considered to be the most satisfactory means of meeting the needs of the City of Chelsea. In order to develop detailed improvement plans, the following four steps were undertaken:

PLAN FORMULATION RATIONALE

CHARACTERISTICS OF THE PROJECTED RECREATIONAL BOAT FLEET

13. The numbers, sizes and types of the boats expected to use the Island End River were estimated using the procedures set forth in Appendix 6.

ESTABLISH THE MARINA LOCATION, SIZE AND CONFIGURATION

14. Marina plans were shown in the Master Plan for the Naval Hospital in concept only. Although the Master Plan projected a capacity of two hundred fifty boats at the marina, there were no detailed drawings establishing the nature or location of piers, floating docks and boat launching ramp.

15. The Master Plan showed the use of the Constitution Magazine Buildings as marina-related commercial buildings. As illustrated in Exhibit 1-1, the existing stone pier behind these buildings was incorporated into the marina and additional piers were shown extending at right angles from the shore into the river.

16. In the Reconnaissance Report, the preliminary plan contained a two-acre turning basin approximately three hundred feet square immediately opposite the existing pier. The Reconnaissance Report made no assumptions about berthing configurations.

17. For the purposes of this study, marina concepts were evaluated in order to locate the channel and to establish the slip capacity.

18. Two alternative marina plans were developed and are illustrated in Figures 2-1 and 2-2. Marina "1" is based on the concept shown in the Master Plan, using the existing stone pier behind Building Two. A boat launching ramp is located at the far upstream end of the marina, while docks extend five hundred fifty feet downstream and seven hundred feet

upstream from the central pier. Marina "1" does not include a turning basin.

19. As shown in Figure 2-2, marina "2" is based on locating the marina facilities upstream of a two acre turning basin. A nonrectangular turning basin was used to correspond to the shape of the river.

20. An evaluation of the marina alternatives indicated that Marina "1" is preferable to Marina "2" for a number of reasons. In general, a turning basin requires an excessive amount of space within the tidal basin. Consequently, in order to accomodate the desired number of berthing slips at the marina, an extensive amount of dredging and bulkheading will probably be required with Marina "2".

21. The costs of development for Marina "2" are therefore higher, both because of more extensive shoreline protection and the larger amount of dredging needed for the marina basin. Assuming an upper limit on the per slip development cost of about $4,000 and further, assuming that no pier construction would occur along the Everett shoreline, the reasonable berthing capacity of Marina "2" is one hundred eighty boats.

22. Marina "1" provides a lower development cost per slip and also accommodates many more boats. There are two disadvantages to this marina configuration. First, the docks located on the downstream end are somewhat distant from the parking area. Secondly, no turning basin is provided.

23. Although Marina "1" does not include a turning basin, it does provide a one hundred foot wide channel adjacent to the berthing area. Most boats using the marina will be power boats less than forty feet in length. These vessels are highly maneuverable and will operate at low speeds in the marina area. In addition, many of the sailboats will probably have auxilary power. For these reasons, a turning basin is not considered a necessity. Elimination of a turning basin will improve the development advantages of the marina, reduce the amount of dredged material and reduce overall project costs. The marina concept shown in Figure 2-1 was, therefore, used as the basis of the development of detailed plans.

ESTABLISH REQUIRED CHANNEL DEPTHS AND WIDTHS

24. Alternative channel depths and widths were analyzed to determine the most cost effective dimensions based on the type of craft expected to use the Island End River. A channel depth of six feet MLW and a channel width of one hundred feet were found to be the most desirable channel dimensions. The determination of channel dimensions is explained in detail in Appendix 6.

DETERMINE ALTERNATIVE CHANNEL LOCATIONS

25. Four separate channel locations were developed for detailed study. These have been designated as Detailed Plans A, B, C and D. These four plans are analyzed in detail in the following section.

DESCRIPTION AND EVALUATION OF DETAILED PLANS

PLAN A

26. Plan A, which is indicated in Figure 2-3, requires the joint use of the existing commercial channel by recreational and commercial craft. The small craft channel would be dredged 1300 feet beyond the upstream end of the existing commercial channel. The channel would be one hundred feet wide by six feet deep at mean low water. It would be located roughly eighty to one hundred feet from, and parallel to, the Everett shoreline.

27. The area to be dredged for the channel generally follows the MLW stream bed. The present elevation of the river bottom ranges between one and one-half feet below to about 3 feet above mean low water.

28. Plan A necessitates the dredging of 52,000 cubic yards of material for the access channel. The marina basin and boat ramp would require the dredging of an additional 65,000 cubic yards, by local interests. This dredging would remove 2.0 acres of intertidal zone and alter an additional 0.5 acres. The dredging impacts of Plan A are summarized in Table 2-1.

29. Cost estimates for Plan A are summarized in Table 2-2. Plan A is estimated to have an initial cost of $519,000 and result in annual net benefits of $238,300.

30. Since Plan A involves the joint use of the existing channel for both commercial and recreational craft, it may have some adverse impacts on existing shipping. There may be some minor delays to shipping, although, legally, the larger, less manuveurable ships have the right of way.

31. Delays to recreational craft are more likely, however, since they would be forced to wait for the barges and freighters to be manuveured in the narrow channel. Delays are more likely to occur when there is heavy recreational boat traffic and when use of the river is restricted to the dredged channel limits at low tide. Based on the number of shipping operations, and the expected length of time for the barges or freighters to be berthed, it is estimated that the recreational benefits of Plan A would be reduced about seven percent due to delays.

32. Safety factors are more difficult to quantify. If all boaters used proper operating procedures and obeyed boating safety regulations, there should be no safety problems. However, there may be a number of inexperienced boaters who might be unaware of the potential safety problems. The primary dangers relate to the potential of collisions due to a small craft cutting across the path of a larger vessel and the potential of a small boat coming too close to the turbulent wash produced by the large commercial tugs.

33. It should be noted, however, that shared use of channels by commercial ships and recreational boats is common in harbor areas and presently occurs in the Mystic River.

TABLE 2-1

Dredging Impacts of Plan A

A) Volume of Dredged Material (cubic yards)

Marina Basin and Ramp	64,900
Access Channel	51,800
TOTAL	116,700

B) Area Dredged (acres)

	Intertidal Area Removed	Intertidal Area Altered
Marina Basin	5.3	1.0
Channel	2.2	0.5
TOTAL	7.5	1.5

Total Intertidal Area in River 19.7 Acres

TABLE 2-2

Plan A Project Cost Estimates

Total First Cost

Dredging (52,000 c.y. @ $7.50/c.y.)	$390,000
Contingencies (15%)	58,500
SUBTOTAL	$448,500
Engineering (7%)	31,400
Supervision and Administration (8%)	35,900
SUBTOTAL	$515,800
Aids to Navigation	3,000
Total First Cost	$518,800

Annual Cost

Amortization (50 years at i = 7-1/8%)	$ 38,200
Annual Maintenance Dredging (4% @ $8.00/c.y.)	16,640
Maintenance of Aids to Navigation	1,500
Total Annual Costs	$ 56,340
SAY	$ 57,000

34. Although no adequate quantitative assessment of the safety impacts can be made, Plan A is considered to have a somewhat adverse impact in this regard. It also presents a second, and difficult to quantify, safety problem relating to the Exxon terminal. Plan A would require recreational craft to pass in close proximity to a facility where large volumes of volatile substances are handled and stored.

35. Another disadvantage of Plan A is that by designation of the existing commercial channel for recreational use, would require Federal acquisition of the channel. Future alteration of the channel or the Everett shoreline as required by the existing industries who paid for the original construction of the channel may be hampered. For example, future extension of piers into the channel or private maintenance dredging could be ruled out due to conflicts in use of the channel by recreational craft. This possible disadvantage to industries located in the City of Everett would occur as a result of a project partially funded by and intended to primarily benefit the City of Chelsea.

PLAN B

36. Plan B, shown in Figure 2-4, involves construction of a separate channel for recreational craft parallel to and contiguous with the existing commercial channel. Upstream of the commercial channel the alignment of the recreational channel would correspond to that in Plan A.

37. The dimensions of the existing channel are marked on Figure 2-4 by the -24 MLW contour. Since all three industries presently use craft with drafts of twentytwo feet, they are constrained to the area shown at mean low water. At present, the channel is somewhat restricted at low water, especially in the area of the Marquette Cement Company wharves.

38. In order to allow for future widening of the commercial channel and to provide an adequate separation between the small craft and the commercial ships, the channel was considered to be bounded as shown in Figure 2-4. For the purposes of delineating the small boat channel from the commercial channel, the latter was considered to be two hundred feet wide at the Exxon terminal at the mouth of the river, then tapering to one hundred twenty feet wide at the northern end of the Coldwater Seafood Corporation wharf. These dimensions will allow for some future widening of the commercial channel in order to permit more clearance past berthed barges at Exxon and Marquette Cement Corporation.

39. Plan B will require navigation aids to mark the eastern edge of the small boat channel and also possibly to mark the separation between the recreational and commercial channels.

40. The major advantage of Plan B over Plan A is the provision of separate channels in the lower portion of the river to eliminate potential navigation conflicts. The safety problems inherent in Plan A are greatly reduced but not eliminated. Even though a separate channel would be provided for small craft, it is likely that some would stray into the commercial channel. In addition, the wash generated by the large tug boats would have some effect in the small boat channel.

TABLE 2-3

Dredging Impacts of Plan B

A) Volume of Dredge Material (cubic yards)

Marina Basin and Ramp	64,900
Access Channel	64,100
TOTAL	129,000

B) Area Dredged (acres)

	Intertidal Area Removed	Intertidal Area Altered
Marina Basin	5.3	1.0
Channel	3.0	1.0
TOTAL	8.3	2.0

Total Intertidal Area in River 19.7 Acres

TABLE 2-4

Plan B Project Cost Estimates

Total First Cost

Dredging	$473,600
(64,000 c.y. @ $7.40/c.y.)	
Contingencies (15%)	544,600
Engineering (7%)	38,100
Supervision and Adminsitration (8%)	43,600
SUBTOTAL	626,300
Aids to Navigation	3,000
TOTAL FIRST COST	$629,300
SAY	$629,000

Annual Costs

Amortization	$ 46,300
(50 years at i = 7.125%)	
Annual Maintenance Dredging	20,500
(4% @ $8.00/c.y.)	
Maintenance of Aids ot Navigation	1,500
TOTAL ANNUAL COSTS	$ 68,300
SAY	$ 68,000

41. Plan B requires the dredging of approximately 64,000 cubic yards for the access channel, the removal of 3.0 acres of intertidal zone and the alteration of 1.0 additional acres. The dredging impacts of the associated non-federal harbor improvements are the same as for Plan A, B, C and D. The dredging impacts of Plan B are summarized in Table 2-3.

42. Plan B is estimated to have an initial construction cost of $629,000 with an equivalent net annual benefits of $249,500. Construction cost estimates are shown in Table 2-4.

PLAN C

43. Plan C is shown in Figure 2-5. It involves construction of a channel for recreational craft on an alignment that is completely separated from the existing commercial channel. At the mouth of the river the small boat channel would be located about 280 feet from the Exxon Corporation wharves. Upstream, the Plan C channel tapers towards the commercial channel. Two small bends are located in the channel, the second at the point where the proposed marina would begin.

44. Plan C corresponds closely to the channel alignment shown in the Reconnaissance Report. The channel alignment is generally as near as possible to the Chelsea shoreline without requiring extensive revetment to provide shore protection.

45. The western edge of the channel in Plan C generally follows the -6 MLW contour. Therefore, Plan C would result in moving the -6 contour one hundred feet to the east. This would provide a great deal of open water in the middle of the river and provide maximum maneuverability.

46. Plan C would require a minimal amount of revetment for a length of two hundred feet along the Chelsea shoreline.

47. As summarized in Table 2-5, Plan C requires the dredging of 89,700 cubic yards of material. Approximately 4.9 acres of intertidal zone area will be removed and an additional 1.9 acres will be altered.

48. The estimated construction cost of Plan C is $872,000 with an annual net benefit of $222,500. The cost estimates for Plan C are summarized in Table 2-6.

PLAN D

49. In Plan D, the small boat channel is aligned as closely as possible to the Chelsea shoreline. The western edge of the proposed channel is separated from the Exxon terminal docks by approximately three hundred eighty feet.

50. In order to retain the desired 3:1 slope, revetment would be required, extending from two feet below MLW to the top of the slope near the sixteen foot elevation. The area where the revetment is proposed for Plan D is along the shoreline of the MDC park. The provision of shore protection along this area is considered to be an aesthetic improvement due to the current poor condition of the area. The bank is presently suffering from

TABLE 2-5

Dredging Impacts of Plan C

A) Volume of Dredged Material (cubic yards)

Marina Basin and Ramp	64,900
Access Channel	89,700
TOTAL	154,600

Intertidal Zone

B) Area Dredged (acres)

	Intertidal Area Removed	Intertidal Area Altered
Marina Basin	5.3	1.0
Channel	4.9	1.9
TOTAL	10.2	2.9

Total Intertidal Area in River 19.7 acres

TABLE 2-6

Plan C Project Cost Estimates

	Total First Cost
Dredging	$657,000
(90,000 c.y. @ $7.30/c.y.)	
Contingencies (15%)	98,600
SUBTOTAL	$755,600
Engineering (7%)	52,900
Supervision and Administration (8%)	60,400
SUBTOTAL	$868,900
Aids to Navigation	3,000
Total First Cost	$871,900
SAY	$872,000

	Annual Costs
Amortization	$ 64,200
(50 years at i = 7-1/8%)	
Annual Maintenance Dredging	28,800
(4% @ $8.00/c.y.)	
Maintenance of Aids to Navigation	1,500
Total Annual Costs	$ 94,500
SAY	$ 95,000

erosion near the high water line and of revetment or retaining walls may have to be constructed by the MDC. It should be noted that shoreline protection is not part of the federal project and would be funded completely by local interests.

51. With respect to navigation, Plan D provides for the maximum separation of small boats and the large ships, and therefore is the safest plan in that respect. However, Plan D would leave potentially hazardous shoals between the small boat channel and the commercial channel. Some of these points in the river bottom would be exposed surfaces two to four feet above MLW and covered at interim tides. Although they would be outside of the small boat channel they could represent a hazard to boaters.

52. Plan D provides a generally straight channel with the easiest navigation from the Mystic River to the proposed marina.

53. Although Plan D has the greatest impact on marine habitats, it is considered to be the most compatible alternative due to its aesthetic improvement of proposed adjacent land uses. The City of Chelsea representatives have expressed an interest in the location of the channel close to the Chelsea shoreline. This is provided by Plan D.

54. The dredging impacts of Plan D are summarized in Table 2-7. Plan D would require the dredging of 110,100 cubic yards of material. It would result in the removal of 6.2 acres and the alteration of 2.3 acres of intertidal zone.

55. Plan D has the maximum impact on intertidal zones near the mouth of the river where marine life is be found in highest concentration.

56. Cost estimates for Plan D are summarized in Table 2-8. Plan D has an estimated construction cost of $1,058,000. The annual net benefits of Plan D are estimated at $202,500.

TABLE 2-7

Dredging Impacts of Plan D

A) Volume of Dredged Material (cubic yards)

Marina Basin and Ramp	64,900
Access Channel	110,100
TOTAL	175,000

B) Area Dredged (acres)

	Intertidal Area Removed	Intertidal Area Altered
Marina Basin	5.3	1.0
Channel	6.2	2.3
TOTAL	11.5	3.3

Total Intertidal Area in River 19.7 acres

TABLE 2-8

Plan D Project Cost Estimates

Total First Cost	
Dredging	$797,500
(110,000 c.y. @ $7.25)	
Contingencies (15%)	119,625
SUBTOTAL	$917,125
Engineering (7%)	64,200
Supervision and Administration (8%)	73,400
SUBTOTAL	$1,057,700
Aids to Navigation	3,000
Total First Cost	$1,057,700
SAY	$1,058,000
Annual Costs	
Amortization	$ 77,900
(50 years at i = 7-1/8%)	
Annual Maintenance Dredging	35,200
(4% @ $8.00/c.y.)	
Maintenance of Aids to Navigation	1,500
Total Annual Costs	$114,600
SAY	$115,000

SECTION C

COMPARISON OF ALTERNATIVE PLANS

57. In general, there is a trade-off between minimizing delays and safety problems for small craft and minimizing the project costs and adverse environmental impacts.

58. By utilizing the existing commercial channel, Plan A minimizes dredging requirements. Therefore, this alternative has the lowest initial as well as annual maintenance cost. Since no dredging will take place in the lower section of the river, it also has the least impact on existing marine life.

59. Plan A, however, has a somewhat adverse impact on boating convenience and safety arising from shared use of the commercial channel by commercial and recreational craft.

60. Plan A would have virtually no impact on the existing environmental conditions downstream of the marina site. Although this would result in the maximum preservation of the intertidal lands, it would not have positive aesthetic impacts. Extensive mudflats would remain adjacent to the proposed waterfront park.

61. Plan B provides more safety and convenience to boaters than Plan A but necessitates expenditures for additional dredging. It also allows for the future expansion of the existing twenty-four foot deep industrial channel to accommodate larger vessels. Plan B requires the dredging of additional intertidal zones in the lower reaches of the river.

62. Plan C provides more separation from the commercial channel by approximately eighty feet at the mouth of the river, therefore, providing a greater margin of safety. Plan C would result in a significant increase in dredging in the lower part of the river.

63. Plan D has the maximum cost and requires the greatest amount of dredging and shoreline protection. However, it also provides the greatest separation between the two channels. This positive safety aspect of Plan D is somewhat reduced by the fact that shoals above the -6 MLW elevation would remain in the center of the river.

64. In general, environmental impacts increase from Plans A to D, since the greatest diversity of marine life is found in the region at the mouth of the river.

65. Aesthetic impacts are considered most positive for Plans C and D due to an increase in open water area at low tide. The City of Chelsea considers increasing the area of open water to be an important factor for enhancing the appearance of the Island End River when viewed from the proposed luxury housing.

66. Through consultation with state, local and federal government agencies and local industries, comments were obtained on the various alternatives. The Marine Division of the Everett Exxon Corporation terminal had objections about shared use of the channel, as proposed under Plan A, due to potential safety problems. The Marine Safety Office of the U. S. Coast Guard also cited potential boating safety problems with Plan A and recommended a widening of the existing channel as in Plan B.

67. Plan A was felt to be the most desirable plan by the Massachusetts Division of Marine Fisheries and the National Marine Fisheries Service, due to the fact that this plan required the least amount of dredging. Plan B was considered to be acceptable, however, if Plan A were shown to have adverse safety impacts. In general, these agencies had objections to Plans C and D.

68. The City of Chelsea is interested in providing the most compatible environment for the proposed waterfront park and housing redevelopment plans for the Naval Hospital property. From their point of view, this is best provided by Plans C and D which will bring the low water line closer to the Chelsea shoreline and remove some of the exposed mud flats.

SYSTEM OF ACCOUNTS

69. The System of Accounts is a summary evaluation required by the Principles and Standards. The System of Accounts provides in a concise format an evaluation of the alternative plans in terms of the national objectives of National Economic Development (NED), Environment Quality (EQ), national accounts of Social WellBeing (SWB) and Regional Development (RD). It also demonstrates plan performance in terms of the planning objectives and constraints; the technical, economic and other criteria, as well as other measures such as plan acceptability.

70. The System of Accounts is shown in Table 2-9. Part A consists of the plan description. Part B contains the Impact Assessment in terms of NED, EQ, SWB and RD. Where impacts are quantifiable, estimated measures of impacts are listed. Unquantifiable impacts are described or are ranked by project. The numbers in parentheses indicate project rankings, "(1)" signifying minimum adverse impacts or maximum positive benefits. A "(4)" indicates the maximum adverse or minimum beneficial impact.

71. Part C of the table illustrates each plan's contribution to the planning objectives or constraints and the detailed criteria. Part D contains information on plan implementation.

72. The summary assessments of the alternative plans shown in Part B of the System of Accounts indicate that the plans have varying responses to the different national objectives and accounts. Pan B is ranked first under the NED objective, based on the criteria of maximum net benefits. Plan A is ranked second on this objective followed by Plans C and D.

TABLE 2-9
SYSTEM OF ACCOUNTS

			Without Project N.A.	Plan A Shared Channel	Plan B Parrallel Channel	Plan C Separate Channel	Plan D Separate Channel
A.	PLAN DESCRIPTON						
B.	IMPACT ASSESSMENT						
1.	NED						
	a.	Annual Benefits	0	$295,300	$317,500	$317,500	$317,500
	b.	Annual Const. Cost	0	38,200	46,300	64,200	77,900
	c.	Annual Maint. Cost	0	18,800	21,700	30,800	37,100
	d.	B/C Ratio	0	5.2	4.7	3.3	2.8
	e.	Net Benefits	0	238,300	249,500	222,500	202,500
2.	EQ						
	a.	Intertidal Zone Removal (Ac)	0	2.2	3.0	4.9	6.2
	b.	Intertidal Zone Altered (Ac)	0	0.5	1.0	1.9	2.3
	c.	Dredging Impacts on Water Quality	-	(1)	(2)	(3)	(4)
	d.	Shoreline Impacts Revetment (l.f.)	0	0	0	200	600
	e.	Aesthetics	-	(4)	(3)	(2)	(1)
	-	Project EQ Rank	-	(1)	(2)	(3)	(4)
3.	SWB						
	a.	Interference with Existing Shipping	-	Yes	Possible	Possible	Possible
	b.	Safety for Recr. Craft	-	(4)	(2)	(1)	(3)
	c.	Accident Potential Exxon Terminal	-	(4)	(3)	(2)	(1)
	d.	Impact on Naval Hospital Plan	Negative	Positive	Positive	Positive	Very Pos.
	e.	Active Recr.	-	(4)	(2)	(1)	(3)
	-	Project SWB Rank	-	(4)	(2)	(1)	(3)
4.	RD						
	a.	Employment & Growth	-	Positive	Positive	Positive	Positive
	-	Project RD Rank	-	(4)	(3)	(2)	(1)

TABLE 2-9
(continued)

	Without Project N.A.	Plan A Shared Channel	Plan B Parallel Channel	Plan C Separate Channel	Plan D Separate Channel
C. PLAN EVALUATION					
1. CONTRIBUTIONS TO PLANNING OBJECTIVES AND CRITERIA					
a. Compatible with Naval Hosp. Plan	No	Yes	Yes	Yes	Best
b. Compatible with MDC Park	No	Yes	Yes	Yes	Best
c. Compatible with Marina	No	Yes	Yes	Yes	Yes
d. Safety and Maneuverability	-	Restricted	Yes	Yes	Yes
e. Minimize Shipping Conflicts	-	No	Yes	Yes	Yes
f. Discourage Boats at Exxon Ter.	No	No	Yes	Yes	Yes
g. Good Channel Alignment	-	Yes	Yes	Yes	Yes
h. Min. Dredging	-	(1)	(2)	(3)	(4)
2. PLAN RESPONSE					
a. Plan Found Unacceptable	Chelsea	Exxon	-	*	*
b. City must Const. Marina	No	Yes	Yes	Yes	Yes
D. IMPLEMENTATION RESPONSIBILITY					
a. Federal Project	-	$259,500	$314,500	$436,000	$529,000
b. Local Share	-	$259,500	$314,500	$436,000	$529,000
3. Marina, Shore Fac. & Improvements					
a. Federal Share (%)	-	0	0	0	0
b. Local Share (%)	-	100	100	100	100

* National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries

73. Plan C is considered to be the plan providing maximum social well-being, since it provides a significant separation from the existing shipping channel yet avoids the safety problems of Plan D. Plan B is ranked second under this account, followed by Plan D and Plan A.

74. Plan D has the maximum positive impact on Regional Development, due to the positive impact on local employment and its compatibility with development of the Naval Hospital property.

Part C of the System of Accounts indicates that, in general, all plans meet the project planning objectives and criteria, with the exception of Plan A. Plan A does not meet the criteria of minimizing shipping conflicts and discouraging boats near the Exxon terminal. Plan A, however, ranks well under the objective of minimizing dredging.

75. Plan Acceptability is summarized under Part C.2. Plan A is judged to be unacceptable to the Exxon Company and the Coast Guard. Plans C and D are judged to be unacceptable to the National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries.

SELECTING A PLAN

76. Selection of a plan for navigation improvements to the Island End River has been based on considerations of economic efficiency, preservation of environmental quality, boating safety and the needs and objectives of local and state governments. Based on these criteria, Plan B is found to be overall the most favorable plan for meeting the project objectives.

NATIONAL ECONOMIC DEVELOPMENT PLAN

77. Of the four alternatives evaluated in this study, Plan B would provide the greatest net benefits. Appendix 6 of this report contains the detailed benefit/cost studies for the four alternatives, including the benefit/cost analysis of the proposed channel dimensions. The National Economic Development Plan is the selected plan.

ENVIRONMENTAL QUALITY PLAN

78. The Environmental Quality Plan is the alternative which makes the most significant contribution to the management, conservation, preservation, creation, restoration or improvement of the quality of certain natural and cultural resources and ecological systems. All four alternatives considered would have positive effects on enhancement, preservation and restoration of cultural resources. In terms of the proposed land uses of housing and recreation adjacent to the river, all of the plans would also have positive aesthetic impacts.

79. Because Plan A would require the least amount of dredging, thereby minimizing the alteration of marine habitats and minimizing the material to be disposed of, Plan A is the Environmental Quality Plan. Plan A has not been selected, however, because Plan A has reduced recreational benefits due to interference with commercial shipping, as well as potential adverse safety problems.

SECTION D
THE SELECTED PLAN

80. This section describes Plan B, the selected plan of improvement for the Island End River. The associated harbor improvements required by Plan B are described in more detail in this section, as are the construction and maintenance procedures. General environmental impacts of the Plan are outlined in this section.

PLAN DESCRIPTION

81. As is shown in Figure 2-4, Plan B will consist of widening the existing industrial channel for approximately 1150 feet upstream from the Mystic River, then dredging a new channel for 1350 feet. Table 2-10 summarizes the major features of Plan B.

Table 2-10
Pertinent Data - Selected Plan

Total length of channel (feet)	2500
Length adjacent to existing channel (feet)	1150
Length upstream of existing channel (feet)	1350
Width of dredging required adjacent to existing channel (feet) (varies)	0-80
Width of channel bottom - new section (feet)	100
Depth of channel MLW (feet)	6
Side slopes below -2 MLW	1 on 3
Side slopes above -2 MLW	1 on 10
Dredge quantity (cubic yards)	64,000
Maintenance, average annual (cubic yards)	2,560

HARBOR IMPROVEMENTS

82. No turning basin or anchorage basin areas have been proposed under the federal part of the selected plan. Instead, the access channel has been designed such that it will extend along the length of the proposed mooring area to be provided by local interests.

83. A conceptual plan for a marina has been developed in this study and is illustrated in Figure 2-1. Such a marina will provide a capacity for mooring approximately two hundred fifty boats, a boat launching ramp and all of the required shore facilities. The concepts shown here were based on information obtained from the Development Master Plan for the Chelsea Naval Hospital. It is estimated that such a plan would require the dredging of 65,000 cubic yards of material and the construction of 1250 feet of revetment along the Chelsea shoreline.

84. It should be noted that the planning, engineering and construction of the marina and related facilities will be the responsibility of the City of Chelsea. It is expected that the final design of the harbor facilities are likely to differ somewhat from the concepts illustrated in this study.

EVALUATED ACCOMPLISHMENTS

85. The evaluated accomplishments that would result from the selected plan of improvements are the recreational benefits that would accrue to boaters in the City of Chelsea and in the greater Boston area. The demand for mooring spaces in the Boston area is greater than the available supply; consequently, new marinas for small boats are required if full benefits are to be derived from recreational boating. The proposed plan would enable the City of Chelsea to develop a facility for small boats in accordance with its stated economic and land use development plans. The selected plan would result in estimated net annual benefits of $249,500.

86. Other accomplishments of the plan which have not been evaluated in economic terms are that it would (1) enhance the presentation and restoration of the historic cultural resources on the Chelsea Naval Hospital property and, (2) enhance the redevelopment of the Naval Hospital property for residential, commercial and industrial uses, thereby adding to the tax base and employment opportunities in the City of Chelsea.

CONSTRUCTION AND MAINTENANCE

87. The dredging contract will specify that the contractor form a channel with a minimum depth of 6 feet at MLW with a one foot allowable overdepth. Dredging of a channel in the Island End River will be affected by the need to schedule the work according to the height of the tide. The current shallow depths in the river will affect the types of equipment that can be used, the method of conducting the dredging and the project cost.

Typical equipment that could be used for this project includes:

- A six-yard clamshell bucket dredge on a small barge (up to one hundred forty feet by forty feet with a six foot draft).
- Two 2,000-yard scows drawing about two feet when empty and about sixteen feet when fully loaded.

88. The dredge, working upstream, would cut the channel to the desired depth from the mouth of the river to the point about eleven hundred feet upstream where the channel makes a bend and the adjacent deepwater channel ends. The scows would be floated alongside in the deeper water that would not have to be dredged. Provisions in the construction documents would require that these scows be moved as necessary to avoid interference with existing commercial shipping activities. In general, the scows could be fully loaded under all tide conditions. This part of the job consisting of approximately 12,000 cubic yards could be conducted fairly routinely. 89.

89. Upstream of the end of the commercial channel, the 100 foot wide small boat channel would be dredged in two cuts, the first being 60 to 70 feet in width. The dredge, working upstream, would clear the first cut to a depth of 6 feet below MLW. Because the dredge barge would have a draft of only six feet, it would clear its own path as it advanced. The scows, however, would have to be loaded next to the dredge where insufficient depth is available. Current bottom elevations range from about -2 to +2 MLW. Since the scows would require two feet of water, even when empty, they could not be loaded at low tide. At high tide, there would be only about eight to

twelve feet of water where the scows would be loaded. Therefore, they could not be loaded to their maximum capacity, even at high tide. The most efficient way of loading the scow would appear to be to bring in an empty scow at low tide and fill it with the rising tide. It would then be floated out at high tide.

90. After the first cut has been made, the dredge would clear the other half of the channel while the scows are loaded in the prevously dredged half. While the scows would now have six feet of water at MLW, it would still be necessary to work around the tides to some extent.

91. Disposal of the dredged material will take place at sea. Appendix 7 sets forth dredged material disposal options.

92. The nature of the dredged material is expected to be primarily mud. However, the test boring has indicated a layer of dense gravel till at five feet below MLW. If such material is encountered, it will tend to reduce the dredging rates.

93. A clamshell dredge could attain a theoretical production rate of 7200 cubic yards per 24 hours. However, substantial downtime is encountered in dredging operations. Daily maintenance requirements, weather delays, tidal variations and similar factors, limit productivity. Under normal conditions, a productivity of 5,000 cubic yards (70 percent efficiency) per 24 hours can be achieved with a 6 cubic yard clamshell mud bucket. However, based on the need to work the tide levels and the possibility of encountering gravel, this rate has been further reduced to a level of 2,000 yards per day for this project. Plan B would, therefore, require thirty two working days to dredge, or about six weeks.

94. Maintenance dredging is estimated to be required at five year intervals, based on a shoaling rate of four percent. Analysis of shoaling rates in the commercial channel indicates very little sedimentation occurring in that part of the river. More rapid sedimentation would occur in the upper part of the river. Sediments transported into the river from upland runoff would be deposited here due to the low velocities. Maintenance dredging is estimated at 2600 cubic yards annually, or about 13,000 yards at five-year intervals.

GENERAL IMPACTS OF CONSTRUCTION

95. The construction of the proposed plan will have both temporary and long-term effects on the environment. Short-term effects include air pollution, noise and water pollution due to the dredging equipment. Long-term effects relate primarily to the alteration of the river bottom.

WATER QUALITY

96. Short-term impacts on water quality will result from oil and grease discharges from dredging equipment, from increases in turbidity, and from the reintroduction of sediment trapped pollutants. Disposal of dredged material will also cause some temporary environmental effects. Appendix 7 contains

further analysis of the impacts of ocean disposal. Of these short-term impacts, the increase in turbidity is probably the most serious. Suspended fine sediments in the water can have a detrimental effect on shellfish and finfish. For this reason dredging of the Island End River will be scheduled to take place in the fall in order to avoid adverse effects on the spring run of the anadromous alewives in the Mystic River.

97. Since there is presently limited use of the Island End River for recreational purposes, such as swimming, fishing or shellfishing, the temporary increase in turbidity will have no adverse effect on these activities.

IMPACTS ON MARINE LIFE

98. Long-term impacts of dredging include removal of existing benthic organisms from the river bottom, removal or alteration of marine habitats in the intertidal zone, and permanent changes to the shoreline and tidal currents in the river.

99. The most prominent marine species expected to be displaced by dredging in the Island End River is the clamworm which was found in fairly high populations near the stream below the low tide mark in the upper part of the river. It is expected that dreding will also result in the permanent removal of some soft shell clams which were found at the downstream end of the river. Long-term impacts will be mitigated by the eventual repopulation of these species in the dredged areas. If desired, shellfish could be reseeded in less polluted environs prior to dredging. No rare or endangered species will be affected by the proposed project.

100. The proposed plan will affect the intertidal zone of the river. The intertidal zone is the area of the river bottom between the low and high water lines. This area is a valuable source of organisms at the lower end of the food chain and also a potential habitat for shellfish. At the present time, harvesting of shellfish in the Island End River is prohibited due to high levels of pollution. In time, the intertidal area of the Island End River could increase in value if water quality is significantly improved. The intertidal zone is eliminated if a section of river bottom is dredged to a depth below MLW. The intertidal zone may be effected by alterations of the river bottom above MLW in order to create the side slopes for the channel (see Appendix 4A).

AIR QUALITY

101. Temporary air pollution impacts will occur during construction due to engine exhaust from the dredge and the tending boats. This air pollution will not have a significant effect since the surrounding area is primarily industrial and the Naval Hospital is unoccupied. The primary air pollution impacts relating to the disposal of the dredge material at sea will be emissions from tow boats.

OTHER IMPACTS

102. By enhancing the plans for restoration of the U.S.S. Constitution Magazine, the proposed project would have a positive effect on historic and cultural resources.

103. The proposed project will have a beneficial impact on the City of Chelsea's plans for redevelopment of the Chelsea Naval Hospital property. It will enhance the ability of the City to provide better community services through added revenues by increasing the limited tax base of the City.

104. The project will also have the beneficial effect of increasing recreational opportunities for the residents of Chelsea and nearby communities.

105. The project may have minor adverse effects due to increased automobile traffic through an existing residential area to the north of the Naval Hospital. However, most of the area surrounding the project site, consists of heavily industrialized land uses which will not be significantly impacted.

106. No existing industrial, commercial or residential porperties will be physically affected by the proposed project. There will be no relocation of residents.

SECTION E

IMPLEMENTATION RESPONSIBILITIES

COST ALLOCATION

107. Allocation of costs of the project are one hundred percent to the channel. There are no other elements of the federal project.

COST APPORTIONMENT

108. Local governments would be responsible for fifty percent of the initial cost of the federal project, or $320,000. Local responsibilities also include a one hundred percent share of related improvements which are not part of the federal project.

FEDERAL RESPONSIBILITIES

109. The federal government will be responsible for contributing fifty percent of the cost of dredging the access channel only. The federal responsibility does not include any marina improvements, shoreline protection or site work at any land disposal area.

LOCAL RESPONSIBILITIES

110. Local responsibilities are as follows:

- Provide a cash contribution toward construction costs This is determined in accordance with existing policies for regularly authorized projects, considering recreational, land enhancement, and special or local benefits expected to accrue. The present basis for cost-sharing in recreational small-boat projects requires that the federal government provide not more than 50 percent of the first costs of general navigation facilities serving recreational traffic.

- Provide, maintain and operate without cost to the United States, an adequate public landing with provisions for the sale of motor fuel, lubricants and potable water open and available to the use of all on equal terms.

- Provide without cost to the United States all necessary lands, easements and rights-of-way required for construction and subsequent maintenance of the project including suitable dredged material disposal areas with necessary retaining dikes, bulkheads and embankments.

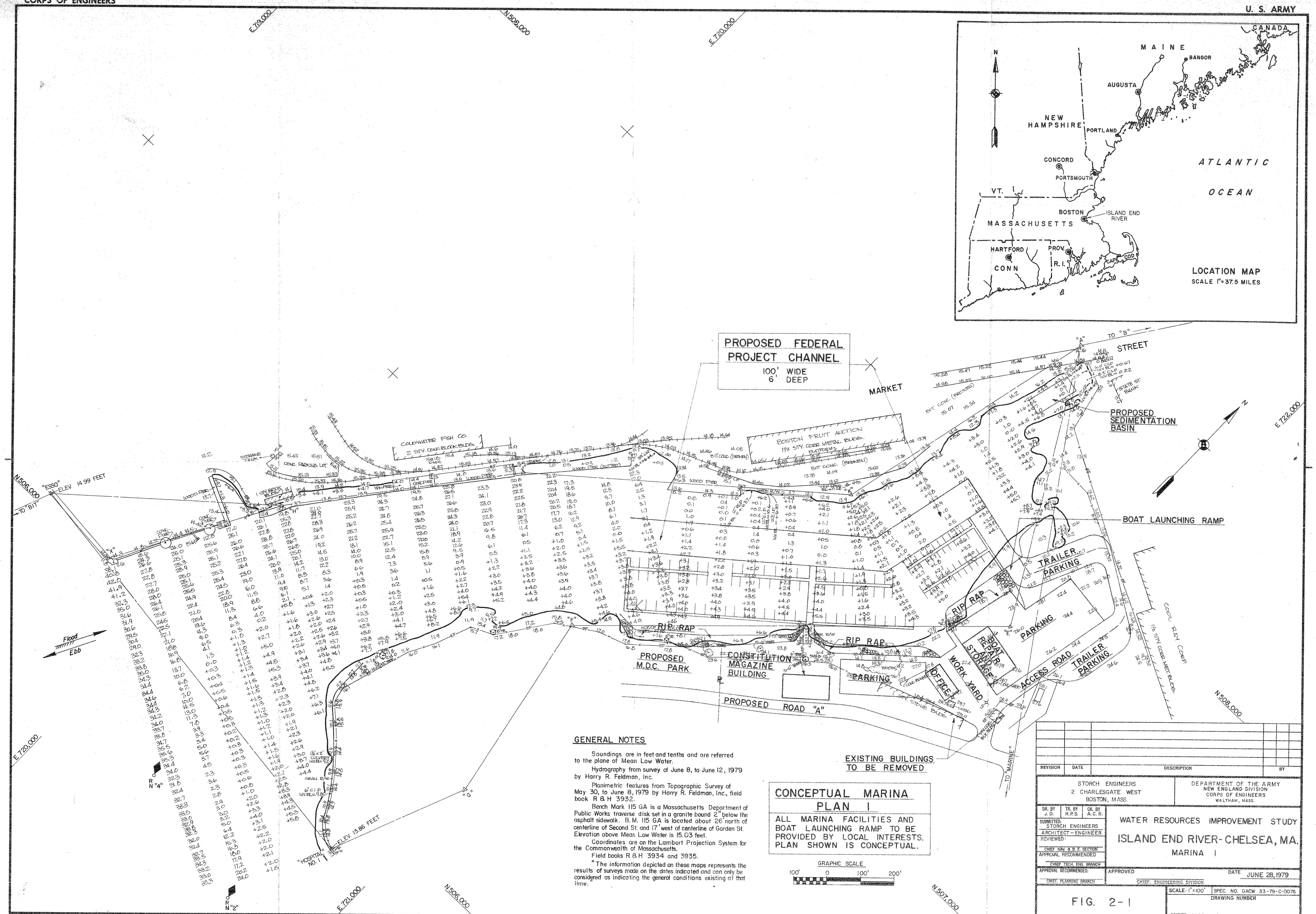
- Hold and save the United States free from damages that may result from construction and maintenance of the project.

- Accomplish without cost to the United States alterations and relocations as required in sewer, water supply, drainage and other utility facilities.

- Provide and maintain berths, floats, piers, and similar marina and mooring facilities as needed for transient and local vessels as well as necessary trailer facilities, access roads, parking areas and other needed public use shore facilities open and available to all on equal terms. Only minimum, base facilities and service are required as part of the project. The actual scope or extent of facilities and services provided over and above the required minimum is a matter of local decision. The manner of financing such facilities and services is a local responsibility.

- Assume full responsibility for all project costs in excess of the federal cost limitation of $2,000,000 under the 107 program.

- Establish regulations prohibiting the discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor, said regulations being in accordance with applicable laws and regulations of federal, state and local authorities responsible for pollution prevention and control.



CONCEPTUAL MARINA PLAN I

ALL MARINA FACILITIES AND BOAT LAUNCHING RAMP TO BE PROVIDED BY LOCAL INTERESTS. PLAN SHOWN IS CONCEPTUAL.

GENERAL NOTES

Soundings are in feet and tenths and are referred to the plane of Mean Low Water.

Hydrography from survey of June 8, to June 12, 1979 by Harry R. Feldman, Inc.

Planimetric features from Topographic Survey of May 30, to June 8, 1979 by Harry R. Feldman, Inc., field book R & H 3932.

Bench Mark 115 GA is a Massachusetts Department of Public Works traverse disk set in a granite bound 2" below the asphalt sidewalk. B. M. 115 GA is located about 26' north of centerline of Second St. and 17' west of centerline of Garden St. Elevation above Mean Low Water is 15.03 feet.

Coordinates are on the Lambert Projection System for the Commonwealth of Massachusetts.

Field books R & H 3934 and 3935.

"The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time."

REVISION	DATE	DESCRIPTION	BY

STORCH ENGINEERS
2 CHARLESGATE WEST
BOSTON, MASS.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY J. D. | TR. BY R.P.S. | CK. BY A.C.B.

SUBMITTED: STORCH ENGINEERS
ARCHITECT – ENGINEER

REVIEWED:
CHIEF NAV. & B. E. SECTION

APPROVAL RECOMMENDED
CHIEF TECH. ENG. BRANCH

APPROVAL RECOMMENDED:
CHIEF, PLANNING BRANCH

WATER RESOURCES IMPROVEMENT STUDY

ISLAND END RIVER - CHELSEA, MA.

MARINA I

APPROVED
CHIEF, ENGINEERING DIVISION

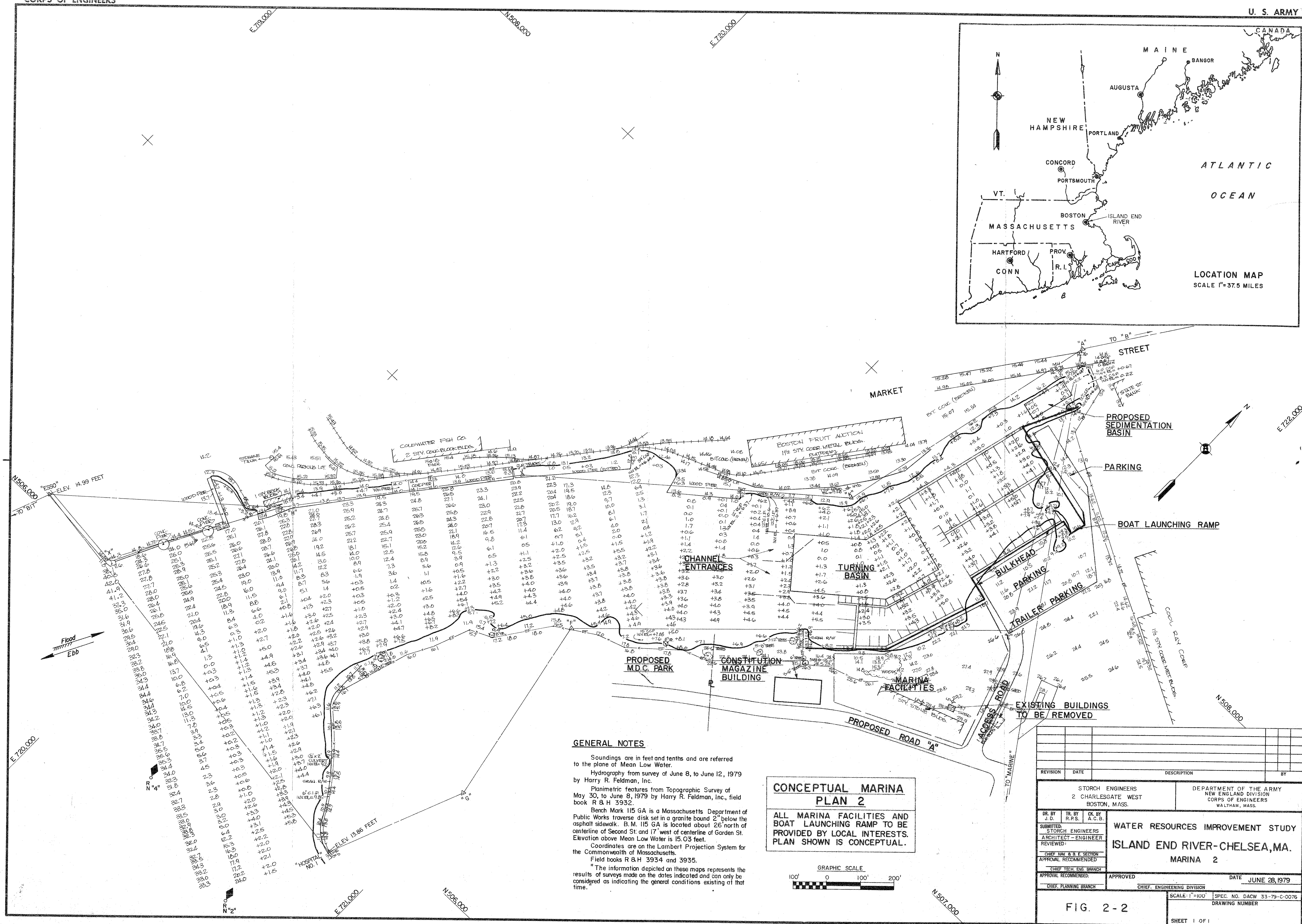
DATE JUNE 28, 1979

SCALE: 1" = 100'
SPEC. NO. DACW 33-79-C-0076
DRAWING NUMBER
SHEET 1 OF 1

FIG. 2-1

CORPS OF ENGINEERS

U. S. ARMY



GENERAL NOTES

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Field books R & H 3934 and 3935.

"The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time."

CONCEPTUAL MARINA PLAN 2

ALL MARINA FACILITIES AND BOAT LAUNCHING RAMP TO BE PROVIDED BY LOCAL INTERESTS. PLAN SHOWN IS CONCEPTUAL.

GRAPHIC SCALE
100' 0 100' 200'

REVISION	DATE	DESCRIPTION	BY

STORCH ENGINEERS
2 CHARLESGATE WEST
BOSTON, MASS.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY J. D.	TR. BY R.P.S.	CK. BY A.C.B.

SUBMITTED: STORCH ENGINEERS
ARCHITECT – ENGINEER
REVIEWED:
CHIEF NAV. & B. E. SECTION
APPROVAL RECOMMENDED
CHIEF TECH. ENG. BRANCH
APPROVAL RECOMMENDED:
CHIEF, PLANNING BRANCH

WATER RESOURCES IMPROVEMENT STUDY

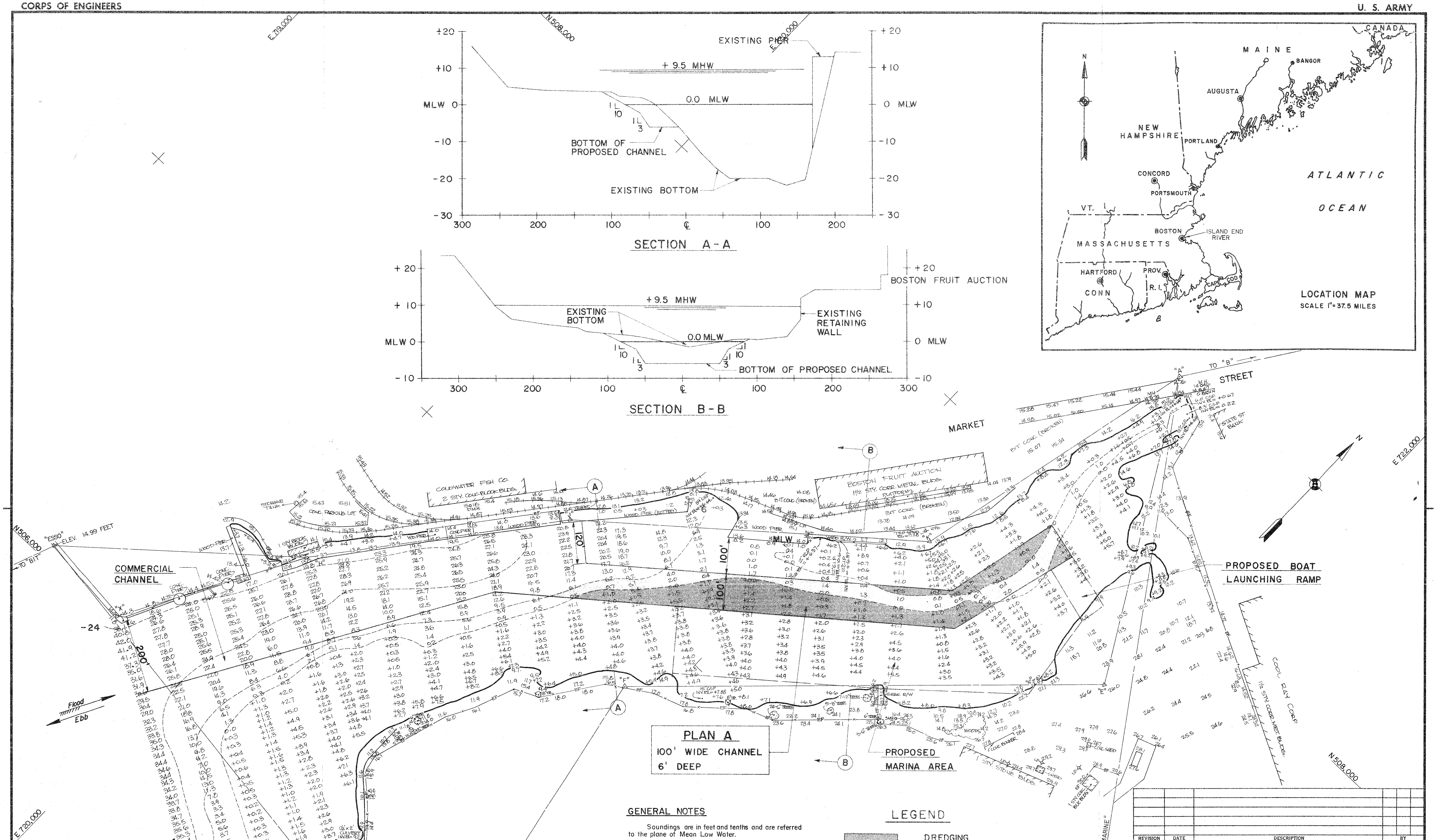
ISLAND END RIVER-CHELSEA, MA.

MARINA 2

APPROVED
CHIEF, ENGINEERING DIVISION
DATE JUNE 28, 1979

FIG. 2-2

SCALE: 1" = 100'
SPEC. NO. DACW 33-79-C-0076
DRAWING NUMBER
SHEET 1 OF 1



GENERAL NOTES

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LEGEND

DREDGING GREATER THAN 6 FEET

DREDGING 0 TO 6 FEET

REVISION	DATE	DESCRIPTION	BY

STORCH ENGINEERS
2 CHARLESGATE WEST
BOSTON, MASS.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY J. D. | TR. BY R.P.S. | CK. BY A.C.B.

SUBMITTED: STORCH ENGINEERS ARCHITECT – ENGINEER

REVIEWED: CHIEF NAV. & B. E. SECTION

APPROVAL RECOMMENDED CHIEF TECH. ENG. BRANCH

APPROVAL RECOMMENDED: CHIEF, PLANNING BRANCH

WATER RESOURCES IMPROVEMENT STUDY
ISLAND END RIVER-CHELSEA, MA.
PLAN A

APPROVED CHIEF, ENGINEERING DIVISION

DATE JUNE 28, 1979

SCALE: 1"=100' | SPEC. NO. DACW 33-79-C-0076

DRAWING NUMBER

FIG. 2-3

SHEET 1 OF 1


CORPS OF ENGINEERS
U. S. ARMY
+9.5 MHW
0.0 MLH
EXISTING PIER
EL-6.0
REMOVE SHOALS BETWEEN CHANNELS
BOTTOM OF PROPOSED CHANNEL
EXISTING BOTTOM
SECTION A-A
REVETMENT
EL.-3.0
0.0 MLW
SECTION B-B
EXISTING RETAINING WALL
100'
SECTION C-C
E 719,000
N 508,000
E 720,000
MAINE
CANADA
BANGOR
AUGUSTA
NEW HAMPSHIRE
PORTLAND
CONCORD
PORTSMOUTH
ATLANTIC OCEAN
VT.
MASSACHUSETTS
BOSTON
ISLAND END RIVER
HARTFORD
PROV.
CONN
R.I.
CAPE COD
LOCATION MAP
SCALE 1"=37.5 MILES
MARKET STREET
TO "B"
BOSTON FRUIT AUCTION
COLDWATER FISH CO.
COMMERCIAL CHANNEL
"ESSO" ELEV. 14.99 FEET
PROPOSED BOAT LAUNCHING RAMP
REVETMENT
PROPOSED MARINA AREA
COOL RAY CORP.
Flood
Ebb
"HOSPITAL NO. 1" ELEV. 13.86 FEET
TO "MARINE"
PLAN C
100' WIDE CHANNEL
6' DEEP
GENERAL NOTES
Soundings are in feet and tenths and are referred to the plane of Mean Low Water.
Hydrography from survey of June 8, to June 12, 1979 by Harry R. Feldman, Inc.
Planimetric features from Topographic Survey of May 30, to June 8, 1979 by Harry R. Feldman, Inc., field book R & H 3932.
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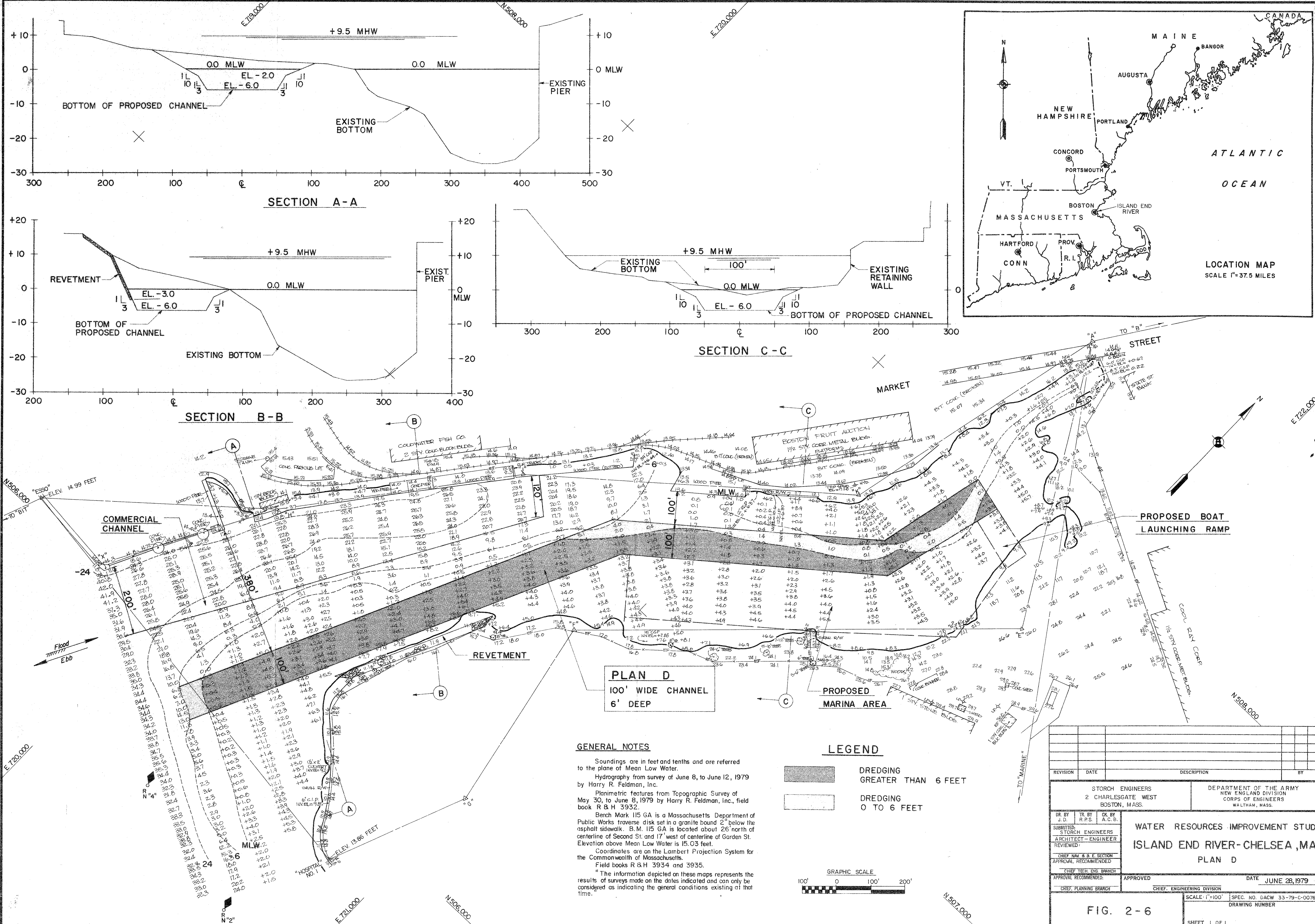
Coordinates are on the Lambert Projection System for the Commonwealth of Massachusetts.
Field books R & H 3934 and 3935.
"The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time."
LEGEND
DREDGING GREATER THAN 6 FEET
DREDGING 0 TO 6 FEET
GRAPHIC SCALE
REVISION
DATE
DESCRIPTION
BY
STORCH ENGINEERS
2 CHARLESGATE WEST
BOSTON, MASS.
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
DR. BY J.D.
TR. BY R.P.S.
CK. BY A.C.B.
SUBMITTED: STORCH ENGINEERS ARCHITECT-ENGINEER
REVIEWED:
CHIEF NAV. & B. E. SECTION
APPROVAL RECOMMENDED
CHIEF TECH. ENG. BRANCH
APPROVAL RECOMMENDED:
CHIEF, PLANNING BRANCH
WATER RESOURCES IMPROVEMENT STUDY
ISLAND END RIVER-CHELSEA, MA.
PLAN C
APPROVED
CHIEF, ENGINEERING DIVISION
DATE JUNE 28, 1979
SCALE: 1"=100'
SPEC. NO. DACW 33-79-C-0076
DRAWING NUMBER
SHEET 1 OF 1
FIG. 2-5

CORPS OF ENGINEERS

U. S. ARMY



GENERAL NOTES

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Field books R & H 3934 and 3935.

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REVISION	DATE	DESCRIPTION	BY

STORCH ENGINEERS
2 CHARLESGATE WEST
BOSTON, MASS.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY J. D. | TR. BY R.P.S. | CK. BY A.C.B.

SUBMITTED: STORCH ENGINEERS
ARCHITECT-ENGINEER
REVIEWED:
CHIEF NAV. & B. E. SECTION
APPROVAL RECOMMENDED
CHIEF TECH. ENG. BRANCH
APPROVAL RECOMMENDED:
CHIEF, PLANNING BRANCH

WATER RESOURCES IMPROVEMENT STUDY
ISLAND END RIVER-CHELSEA, MA.
PLAN D

APPROVED
CHIEF, ENGINEERING DIVISION
DATE JUNE 28, 1979

SCALE: 1"=100' | SPEC. NO. DACW 33-79-C-0076
DRAWING NUMBER
SHEET 1 OF 1

FIG. 2-6

APPENDIX 3

PUBLIC VIEWS AND RESPONSES

APPENDIX 3

PUBLIC VIEWS AND RESPONSES

SECTION A

PUBLIC INVOLVEMENT PROGRAM

1. Views of government agencies were obtained through initial contacts by telephone, written correspondence and meetings. A major reivew meeting was held at which the four detailed plans were reviewed and which was attended by representatives of the City of Chelsea, the Massachusetts Office of Coastal Zone Management, the Massachusetts Division of Marine Fisheries, and the National Marine Fisheries Service. The following is a summary of the major comments received during the coordination phase.

FEDERAL AGENCIES

U.S. COAST GUARD, AIDS TO NAVIGATION BRANCH

2. Existing navigation aids in the Island End River are being improved per request of Coldwater Seafood Corporation. Additional navigation aids would be required if a separate small boat channel is dredged. They did not forsee any significant navigation problems with any of the alternatives.

U.S. COAST GUARD, OFFICE OF MARINE SAFETY

3. Expressed concern over the safety aspects of Plan A, and recommended a separate channel as under Plans B, C and D in order to reduce the conflicts with industrial shipping and to avoid encouraging recreational boating close to the Exxon terminal.

U.S. FISH AND WILDLIFE SERVICE

4. Expressed opposition to the Reconnaissance Report plan. Recommended that Plan A be considered in order to minimize the impacts on marine life.

NATIONAL MARINE FISHERIES SERVICE

5. Felt that Plan A was most desirable because of minimal dredging impacts and effects on marine life, but also felt that Plan B was acceptable because of the safety aspects of Plan A. Objected to Plans C and D.

STATE AGENCIES

OFFICE OF COASTAL ZONE MANAGEMENT

They felt the project should consider the future industrial needs of Everett industries. Land disposal of dredge material should be given first priority over ocean dumping.

DIVISION OF MARINE FISHERIES

7. Felt that Plan A was the most desirable because of the minimum amount of dredging, but that Plan B was acceptable. They objected to Plans C and D.

DIVISION OF SOLID WASTE DISPOSAL

8. They indicated that disposal of dredged material on land is considered a severe problem. State review of land disposal plans would be required and special provisions would be needed, if land disposal is selected.

DIVISION OF WATER POLLUTION CONTROL

9. They believe that the dredged material will be highly contaminated and they thought a containment boom should be used to prevent the spread of oil. They also believe that disposal of dredged material would require water pollution abatement measures.

LOCAL GOVERNMENT AGENCIES

CITY OF CHELSEA

10. The City, through its spokesman, Urban Consulting Associates of Boston, expressed concern for the adverse odor and visual effects of the river's mud flats on the Naval Hospital redevelopment plans. The City would prefer to have the amount of open water in the river increased, particularly in proximity to the Chelsea shoreline. They feel the river has minimal ecological value in its present condition. Consequently, they prefer Plans C and D. Land disposal of dredge spoils on the Naval Hospital property is not desirable because it interferes with redevelopment plans.

OTHER GOVERNMENT AGENCIES

METROPOLITAN AREA PLANNING COUNCIL

11. Supported the project in general, citing the need for recreational opportunities and waterfront access for Mystic River communities.

MASSACHUSETTS PORT AUTHORITY

12. Although unable to make a committment to accept dredge material at the site of its proposed Container Port facility in South Boston, Massport indicated that the material might be accommodated if project schedules can be coordinated and if the dredged materials were similar in nature to other materials to be disposed of in the landfill site.

PRIVATE INDUSTRIES

EXXON CORPORATION

13. Exxon expressed concern about the accident potential inherent in Plan A, due to the large quantities of volatile chemicals handled at the terminal.

They are also concerned about collision potential and trespass. They felt that a small boat channel should be located as far as possible from their terminal.

COLDWATER SEAFOOD CORPORATON

14. They are more concerned about trespass than with collision possibilities.

MARQUETTE CEMENT CORPORATION

15. They stated that navigational improvements for small craft would have a minimal effect on their operations.

DISTRIGAS CORPORATION

16. They felt that navigational improvements for small craft would have a minimal effect on operations at their liquid natural gas facility on the Mystic River. There are already marina facilities along the Mystic River and numerous small craft presently use the river.

SECTION B

COPIES OF CORRESPONDENCE

17. Copies of correspondence received regarding this study are included on the following pages.

Navigation

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P.O. Box 1518
Concord, New Hampshire 03301

JUN 0 1 1979

RECEIVED
JUN 2 1 1979
STORCH ENGINEERS

Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This planning aid letter is intended to aid in your planning efforts for a navigation project in Island End River, Chelsea, Massachusetts. Your study is authorized by Section 107 of the Rivers and Harbors Act of 1960, as amended. This report is submitted under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Island End River, about one-half mile long and 500 feet wide, is a tidal inlet located on the north side of the Mystic River and about one-half mile west of the confluence of the Mystic River and Boston Inner Harbor. The east side of the Island End River is relatively undeveloped and is the grounds of the former Chelsea Naval Hospital. The west shore is built up with commercial properties and the shoreline is lined with old wooden docks. The boundary between Chelsea and Everett runs along the approximate center of the river and the Chelsea (east) side is almost entirely a tidal flat.

An existing channel, 25 to 28 feet deep and about 100 feet wide, lies along the west side of the river. This channel is about 1,500 feet long. There is a small inflow to the river through a culvert at the upstream end.

The proposed work consists of a 2-acre turning basin to be dredged at the inland end of the channel and a 2,000 foot long channel 100 feet wide, to be dredged parallel to the east shore to the Mystic River. The turning basin and channel would be dredged to a depth of 7 feet at mean low water. The minimum area to be dredged would be about six and one-half acres not including allowances for side slope and depth of cut.

The Reconnaissance Report[1] predicts that 250 boats will eventually use marina facilities to be developed by the City of Chelsea along with development of the Chelsea Naval Hospital area for housing, recreation

[1]Department of the Army, New England Division, Corps of Engineers, November 1978. Island End River, Chelsea, Mass.; Small Boat Navigation Project, Reconnaissance Report.

JUN 4 1979

and industry. Dredging of the marina to accommodate the recreation boats used to justify the project is not described in the Reconnaissance Report. The details of this additional dredging should be included in the Detailed Project Report. The number of acres to be dredged, location of dredging, marina facilities to be constructed, depth of dredging, and amount and anticipated proposed spoil disposal procedures should be described.

The project site was visited on May 16, 1979, by biologists from this office and the Massachusetts Division of Marine Fisheries. It was found that the bottom materials on the intertidal area range from soft muds to rather firm gravel and sandy materials in the upper 6 to 12 inches. A clay base was found under the upper layers over much of the area. The upper 6 to 12 inches of substrate was found to be saturated with oil, and patches of tar several square feet in area were found at the upper tide levels. There were patches of oil sheen on the surface of the river.

In spite of the polluted condition of the flat, soft-shell clams were found at the confluence of the Mystic and Island End Rivers and for several hundred feet upstream along the Island End River. The clam population became sparse further upstream on the Island End River. The clams found ranged in size from 1/4 inch to 3 inches indicating that some reproduction was taking place. Barnacles were found on rocks along the Mystic River. Green crabs and a few blue mussels were found near the mouth of Island End River. Abundant populations of clam worms were found. They seemed to be generally located throughout much of the intertidal area near the mouth of Island End River but were confined to the channelward margins of the intertidal area in the upper sections of the river. A snowy egret was seen on the tidal flat.

The soft-shell clams cannot be harvested due to pollution; however, they probably provide a seed source for other areas of Boston Harbor. The clam worms could be taken as bait and a source for stocking other areas in the harbor. Conditions are expected to improve in the future as a result of pollution abatement activities. Tidal flats are now limited in the Boston Harbor area.

An alternate to dredging the 2,000 foot long channel through the tidal flat is to make use of the existing channel for recreational boats. This would reduce the proposed channel from 2,000 feet to about 700 feet and result in a significant reduction of spoil material for disposal and reduce disturbance of the substrate that could cause distribution of additional pollutants through the nearby waters. This alternate should be considered as an Environmental Quality Plan.

Potential problems of interference between ships and recreational craft could be minimized by marking the eastern edge of the existing channel for recreation boats. This edge of the channel slopes steeply to depths

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STORCH ENGINEERS

of 6 feet or more from mean low water. There should be no interference when the ships are tied up. Passage of recreation craft could be delayed, or restricted to the east side, when ships are turning or moving in the river. A traffic control system of warning signals might be necessary.

The Reconnaissance Report shows that the Marquette Cement Corporation receives one barge per month, the Coldwater Seafood Corporation handled 20 vessels during the first six months of 1978, and the Exxon Corporation handles about 500 vessels per year. The Exxon facilities are located at the mouth of the river and some of their vessels tie up along the Mystic River, not entering the Island End River.

Even though the tidal flat is polluted, we feel that it still has a sufficiently viable benthic population to warrant its preservation in view of the fact that an alternate exists which will reduce new dredging by about 70 percent and cause significant reduction in the amount of polluted spoil to be dredged.

Upland spoil sites should be utilized for disposal. Spoil should not be placed on intertidal areas or dumped at sea. The amount of sediments that will need to be dredged for future maintenance and the expected degree of pollution of the sediments should be predicted so that specific arrangements for upland disposal of maintenance dredging spoils can be incorporated into the project plan.

If the 2,000 foot channel is selected for dredging, biological studies will be necessary to determine the average annual loss in benthic organisms over the project life. There appears to be little possibility of constructing new tidal flats in the Boston Harbor area to mitigate the loss.

This Service will carefully review any future permits for dredging of a marina or for other developments to assure that destruction of intertidal habitat is minimized. We will probably object to dredging of a 2,000 foot channel through these tidal flats if that plan is selected.

We recommend that:

1. An alternate channel leading from the proposed turning basin to the existing channel be selected to avoid dredging the proposed 2,000 foot channel.

2. Upland sites be found for spoil disposal including any future spoil from maintenance dredging.

3. Details of the proposed or anticipated marina development be incorporated into the Detailed Project Report.

Sincerely yours,

Gordon E. Becket

Gordon E. Becket
Supervisor

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JUN 21 1979

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DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
Captain of the Port
U. S. Coast Guard
Marine Safety Office
447 Commercial Street
Boston, MA 02109

16611
16 July 1979

Mr. David A. Kinnecom
Storch Engineers
Two Charlesgate West
Boston, MA 02215

Dear Mr. Kinnecom:

This is in response to your letter of 20 June 1979 regarding the feasibility of alternate plans to improve channel access to a proposed recreational marina at the former Chelsea Naval Hospital.

Following are remarks concerning the three alternatives you listed:

(1) "Extending the present channel . . ." is the least desirable alternate due to the interface of commercial and recreational traffic that would result. The opposition expressed by Exxon is quite valid and should be seriously considered. They do handle a large amount of volatile material.

(2) "Constructing an entirely new channel . . ." would be an ideal solution but would likely prove cost prohibitive.

(3) "Widening the existing channel . . ." is the most practical of the three and the choice most favored by this office. We suggest that you consider the necessity of a buoyage system on the eastern side of Island End River.

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JUL 2 3 1979
STORCH ENGINEERS

The Boating Safety Branch of the First District Office compiles data on recreational boating accidents. They have advised us that such data for a specific location is not readily available.

If we can be of any further assistance, please feel free to contact us.

Sincerely,

R Barry Eldridge

R. BARRY ELDRIDGE
Captain
U. S. Coast Guard
Captain of the Port
Boston, Massachusetts

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Federal Building, 14 Elm Street
Gloucester, Massachusetts 01930

June 6, 1979 FNE62:CLM

Col. John P. Chandler
Division Engineer
Department of the Army
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Chandler:

This is in reference to the Reconnaissance Report concerning Small Boat Navigation Improvements for the Island End River at Chelsea, Massachusetts.

We have reviewed the report and the U.S. Fish and Wildlife Service planning aid letter, dated June 1, 1979 (copy enclosed).

Due to manpower and time restraints, we have not been able to conduct our own investigation. However, because of the potential for adverse impacts to fishery resources in the Island End River, we concur and support the findings and recommendations of the referenced U.S. Fish and Wildlife Service planning aid letter. We also recommend that the existing channel be rehabilitated, as opposed to dredging a new one, and that spoil material not be placed on intertidal areas. Further, the proposed marina development should be described in more detail in future correspondence.

Please keep us informed of any action taken on this project.

Sincerely,

Robert W. Hanks
Acting Regional Director

Enclosure

RECEIVED
JUN 21 1979
STORCH ENGINEERS

RAYMOND H. HAMSON JR.

Customhouse Broker & Foreign Freight Forwarder

CABLE ADDRESS
HAMSON-BOSTON

99 STATE STREET
BOSTON, MASS. 02109

TEL. (617) 227-8996
TELEX 940717

May 17, 1979

Commander (oan)
First Coast Guard District
150 Causeway St.
Boston, Mass. 02114

Attention Lieutenant Commander J. F. Overath
Assistant Chief, Aids to Navigation

Dear Sir:

Thank you for your letter dated March 22, 1979 in reply to my telephone call to you in regard to establishment or relocation of a buoy to better mark the entrance of Island End River.

Kindly find attached correspondence I received from Coldwater Seafood Corp., 60 Commercial St., Everett, Mass. answering the excerpts from the Code of Federal Regulations which you requested.

The only addition I have to make is that the Office of the Boston Pilots have advised me that a "Dolphin" would be best suited in place of a new buoy as the "Dolphin" would not move at low tide whereas the buoy might.

Please be advised that I represent the following Steamship Lines that call at the dock of the Coldwater Seafood Corp. in the Island End River:

Iceland Steamship Co. Ltd.
Reykjavik, Iceland

Copenhagen Reefers
Copenhagen, Denmark

Thanking you for your attention in this matter, I remain

Very truly yours,

RAYMOND H. HAMSON JR.

R H Hamson

RECEIVED
1979

RECEIVED
AIDS TO NAVIGATION
BRANCH

RHH/jr
Enclosures Various

MAY 18 1979

Coldwater Seafood Corporation
Icelandic Brand Seafoods

60 COMMERCIAL STREET · EVERETT, MASSACHUSETTS 02149 · TELEPHONE (617) 387-2050
TELEX: 94-4343 CABLE: ICEFILLET, EVERETT, MASSACHUSETTS

March 27, 1979

Mr. Raymond H. Hamson
Ship Agent
99 State Street
Boston, MA 02109

RECEIVED
MAR [illegible] 1979
RAYMOND H. HAMSON

Dear Mr. Hamson,

Attached are answers to the questions from title 33 Code of Federal Regulations revised 7-77.

I hope you find this helpful in justifying the location of a marker bouy.

Sincerely yours,

Thorsteinn Gislason

Thorsteinn Gislason, Jr.
Vice President

TGj:djp

encl.

Coldwater Seafood Corporation

MAR 2 1979
RAYMOND H. HAMSON

RESPONSE TO TITLE 33 CODE OF FEDERAL
REGULATIONS (rev. 7-77)

33 C.F.R. S62 10-1 (B) 1

In 1978, which is a typical year, Coldwater Seafood Corporation which has a docking facility approximately half way up the Island End River had traffic as follows:

Quantity	Type	Capacity	Value
36	Refrigerated Freighter	3000-4000 D.W.T.	approx. $100,000,000

These vessels traverse the area at all seasons both by day and by night.

33 C.F.R. S62. 10-1 (B) 2

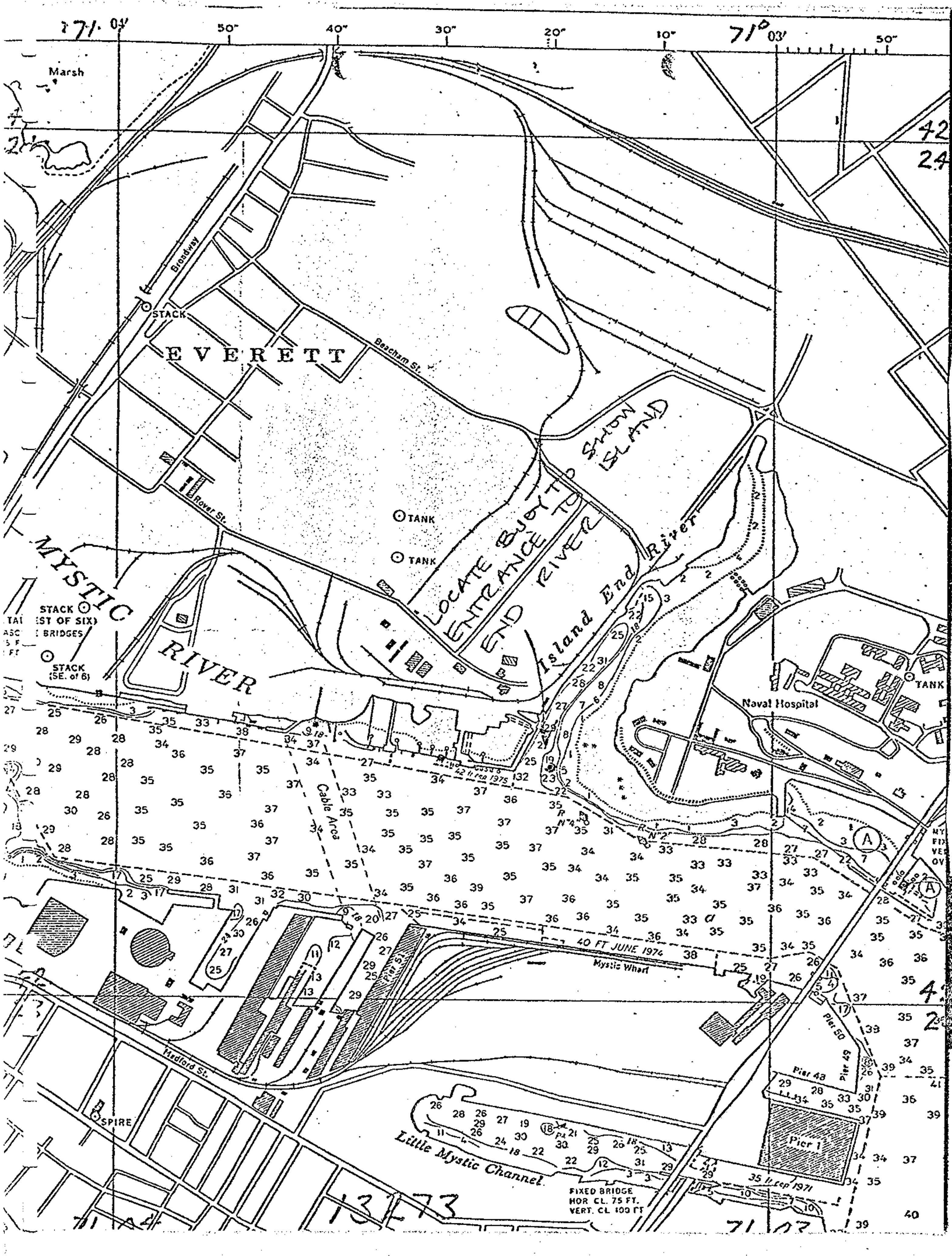
All the vessels in question had radio direction finders, 2 radars, Loran-C and search lights. Some of the vessels were also equipped with satellite location devices. All vessels were equipped with depth finders.

33 C.F.R. S62. 10-1 (B) 3

The vessels in question carried approximately 15 passengers. Their principal cargo consisted of frozen processed seafood. They carried approximately 50 thousand tons of frozen seafood products with a value of approximately 100 million dollars. Also the Marquette Cement Company receives approximately 8 barge loads of bulk cement. Estimated tonnage of cement: 45 thousand tons with a value of approximately 200 thousand dollars.

33 C.F.R. S62. 10-1 (B) 4

Attached is a copy of Charlet 13273 (2) showing the proposed location of a buoy to be located at the entrance of the Island End River. A buoy location is to be selected so that ships entering the Island End River will not assume that it is safe to turn to starboard when they pass the buoy marked N"4" after passing under the Mystic River Bridge. The buoy would indicate channel location at the entrance of the Island End River on the side of the river nearer to the Naval Hospital.


71° 04'
50"
40"
30"
20"
10"
71° 03'
50"
Marsh
42
24
Broadway
STACK
EVERETT
Beacham St.
Rover St.
TANK
TANK
MYSTIC
RIVER
STACK
STACK (SE. of 6)
LOCATE BUOY TO SHOW
ISLAND
ENTRANCE TO
END RIVER
Island End River
Naval Hospital
TANK
Cable Area
42 ft Feb 1975
40 FT JUNE 1974
Mystic Wharf
Pier 51
Medford St.
SPIRE
Little Mystic Channel
FIXED BRIDGE
HOR. CL. 75 FT.
VERT. CL. 100 FT
35 ft Sep 1971
Pier 1
Pier 48
Pier 49
Pier 50
13273

APPENDIX 4

ENGINEERING INVESTIGATIONS, DESIGN AND COST ESTIMATES

APPENDIX 4

ENGINEERING INVESTIGATIONS, DESIGN AND COST ESTIMATES

SECTION A

SELECTION OF CHANNEL CROSS SECTION ELEMENTS

CHANNEL CROSS SECTION

1. Side slope design criteria were as follows:
   Ratio of horizontal to vertical below 2 feet below MLW: 3/1
   Ratio of horizontal to vertical above 2 feet below MLW: 10/1

2. In developing these criteria consideration was given to existing slopes in the bottom of the Island End River. In the portions of the river bottom above MLW with muddy surfaces, the existing slopes generally do not exceed 10:1. Below the low water line, slopes of the existing dredged channel appear to have stabilized at a 3:1 slope.

3. During the dredging process, no attempt would be made to grade the side slopes to these design criteria. Rather, the slopes would be created as shown in Figure 4-1. The channel would be dredged to an extra width as indicated in Figure 4-1 (b), such that Area "A" would be equal to Area "B". The slopes would then eventually stabilize themselves while preserving the desired 100 foot channel width.

4. Figure 4-1 (d) illustrates the impacts of the dredging on the intertidal zones in the river bottom. Estimates of intertidal area removed and altered were used as one measure of environmental impact of the dredging. It should be noted that in many cases, "alterations" of intertidal zones will actually have very minimal impacts.

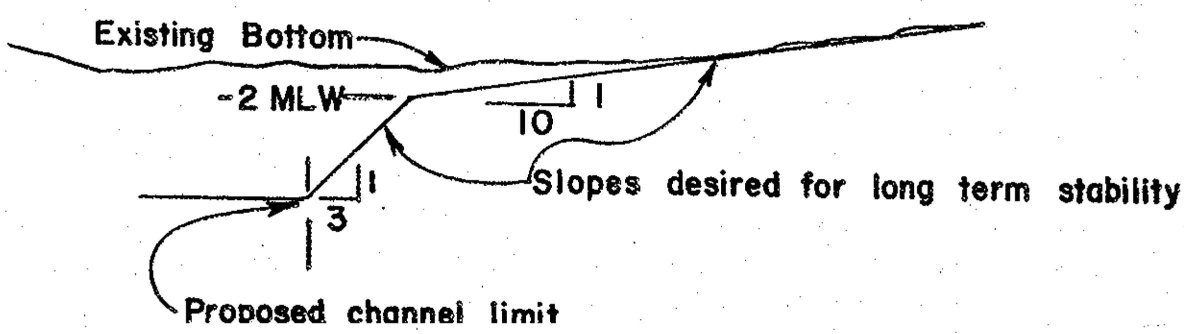
SHORELINE PROTECTION

Plans C and D would require the use of shoreline protection along a portion of the eastern bank of the river. Revetment and bulkheads were analyzed to determine the most effective form of slope protection.

Both revetment and bulkhead walls are commonly encountered in harbors. They can, however, present some safety hazards to small boats. The hidden underwater portions of a revetted slope can damage a boat's hull if it runs aground. This could happen due to a loss of power or if the boat is operated improperly or carelessly. Provided the collision happened at a low speed, damage would be minimal. All vessels in habor areas should operate at low speed. Therefore, for properly operated small craft or for small craft that have suffered a loss of power, the dangers incurred by collision with the hidden underwater portion of a revetted slope would be minimized.

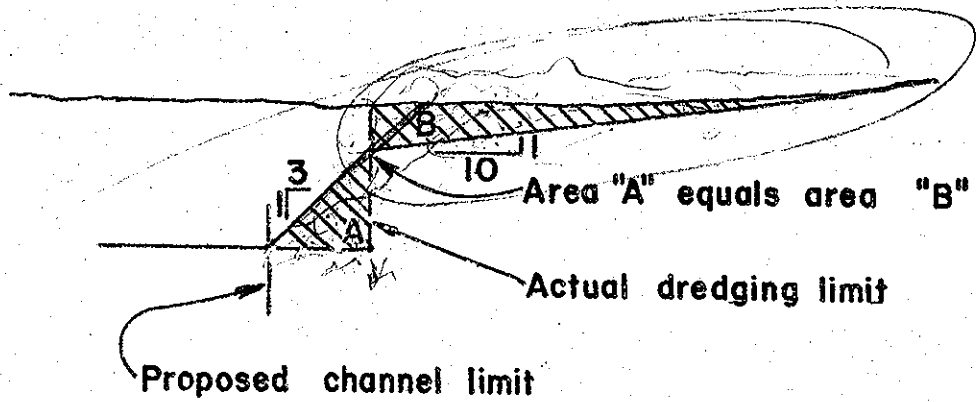
CHANNEL SIDE SLOPES

a)

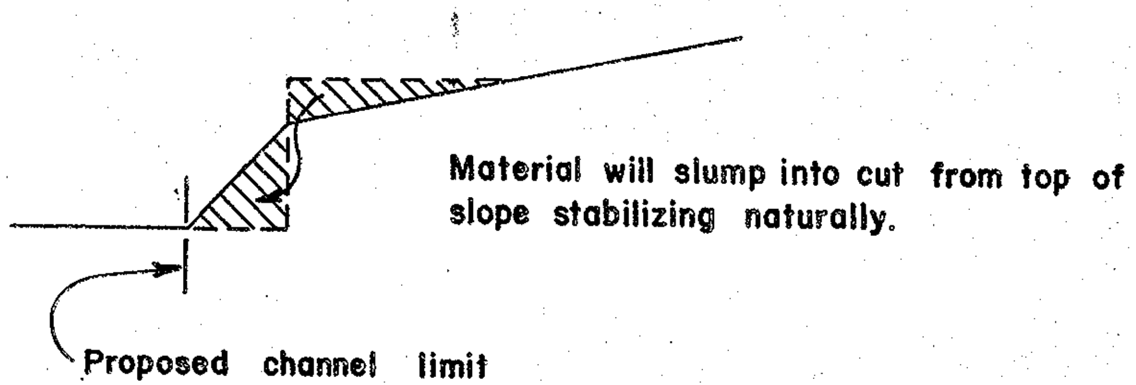


CHANNEL SIDE SLOPES

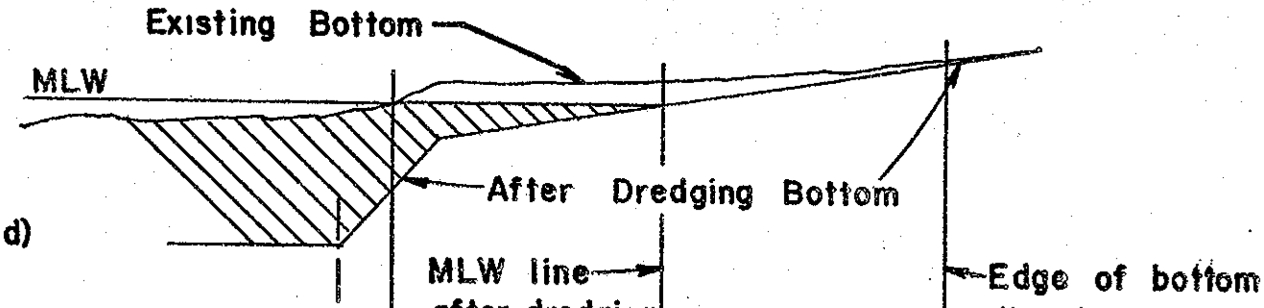
b)



c)



d)



The use of bulkheads would minimize the potential for underwater damage as the bottom adjacent to it could be of existing material. It would, however, present another potential safety problem. If a boat were to sink near the bulkhead, the occupants would not be able to safely scramble ashore, as they could not climb up the vertical bulkhead wall. Inexperienced operators might also mistake the bulkhead for a docking facility resulting in possible groundings.

Bulkheads would be considerably more expensive than revetment. The use of bulkhead rather than revetment would add approximately $100,000 to the cost of Plan D. This additional cost does not appear to be warranted based upon safety considerations.

SECTION B

SUBSURFACE TEST BORING

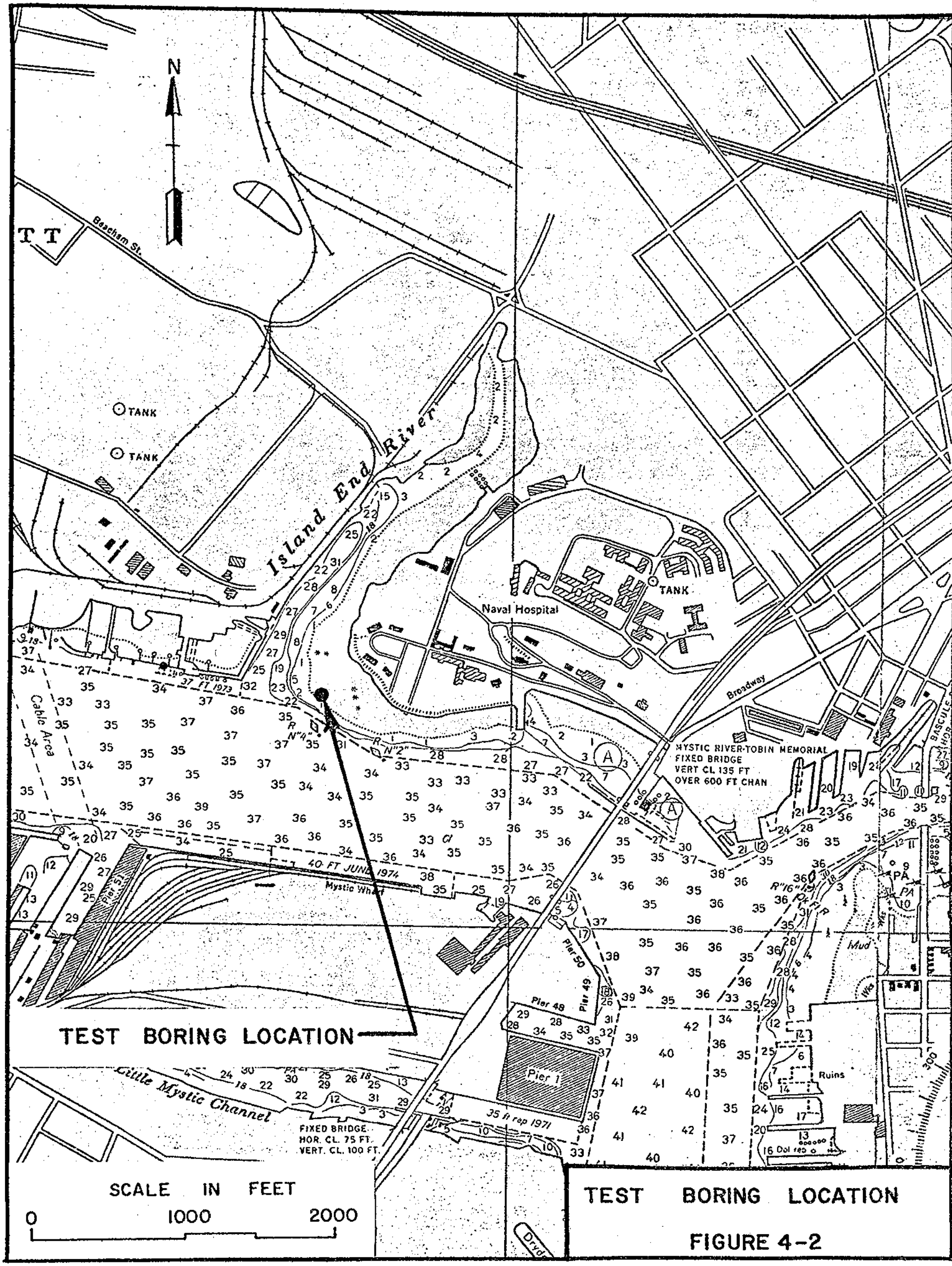
5. A test boring was taken at the location shown in Figure 4-2 in order to obtain a preliminary indication of subsurface conditions in the Island End River. The boring was taken under the supervision of personnel from the Corps of Engineers.

6. According to information supplied by the Corps of Engineers the boring encountered a layer of organic, sandy clay containing petroleum residues and shell fragments between MLW and 1.5 MLW. Between 1.5 MLW and 5.0 MLW gravelly, sandy clay was found. Below 5.0 MLW the material consisted of sandy gravel till.

7. The boring was taken by driving a 2" I.D. by 5.0' spoon to a depth of 10.0 MLW. A hammer weight of 350 pounds with a drop of 18" was used. At a depth of about 5.0', corresponding to the depth at which the gravel till was found, the number of blows per foot increased from 16 to 73.

8. If this boring is representative of conditions throughout the river, most of the dredged material is likely to be sand and clay that can easily be removed with a clamshell bucket dredge.

73 encountered at 4' -



TEST BORING LOCATION

FIGURE 4-2

SUMMARY OF TEST BORING*

Elevation of Top of Boring ~~MSL~~ MLW — Hammer Weight 350

Elevation of Bottom of Boring -10 — Hammer Drop 18"

DEPTH	BLOWS PER FT.	CLASSIFICATION OF MATERIAL
0	PUSHED WITH EASE BY HAND	Black organic sandy clay with shell fragments with petroleum odor.
-1.0	PUSHED WITH DIFFICULTY BY HAND	
	8	Brown with grey gravelly sandy clay.
-2.0	10	
-3.0	16	
-4.0	73	?
-5.0	59	
-6.0	57	Grey and brown stratified clayey sandy gravel till.
-7.0	64	
-8.0	110	
-9.0	155	
10		

* Boring conducted by U.S. Army Corps of Engineers, April 24, 1979. Classification of materials by U.S.A.C.O.E.

FIGURE 4-3

SECTION C

GEOLOGIC ANALYSIS

SECTION D

DREDGING COST ESTIMATES

9. Dredging of a channel in the Island End River will be affected by the need to schedule the work according to the height of the tide. The present shallow depths in the river will affect the types of dredging equipment, the methods of dredging and the project cost.

10. Typical equipment that could be used for this project include:

- A sixyard clamshell bucket dredge on a small barge (up to one hundred forty feet by forty feet with a six foot draft).
- Two 2,000 yard scows drawing about two feet when empty and about sixteen feet when fully loaded.

11. Different procedures would be required to dredge various portions of the channel.

12. The dredge, working upstream, could cut the channel to the desired depth from the mouth of the river to the point about eleven hundred feet upstream where the channel makes a bend and the adjacent deepwater channel ends. The scows would be floated alongside the deeper water that would not have to be dredged. In general, the scows could be fully loaded under all tide conditions. This part of the job consisting of approximately 12,000 cubic yards would be conducted fairly routinely.

13. Upstream of the end of the commercial channel, the small boat channel would be dredged in two cuts. The dredge, working upstream, would clear the channel to a portion of its width to its full depth. Because the dredge barge would have a draft of only six feet, it would clear its own path as it advanced. The scows, however, would have to be loaded next to the dredge where insufficient depth is available. Current bottom elevations range from about 2 to +2 MLW. Since the scows would require two feet of water, even when empty, they could not be loaded at low tide. At high tide, there would be only about eight to twelve feet of water where the scows would be loaded. Therefore, they could not be loaded to their maximum capacity, even at high tide. The most efficient way of loading the scow would appear to be to bring in an empty scow at low tide and fill it with the rising tide. It would then be floated out at high tide.

14. After the first fifty foot wide cut has been made, the dredge would clear the other half of the channel while the scows are loaded in the previously dredged half. While the scows would now have six feet of water at MLW, it would still be necessary to work around the tides to some extent.

15. Disposal of the dredged material will take place at sea. Appendix 7 contains a detailed analysis of dredged material disposal options.

16. The nature of the dredged material is expected to be primarily mud. However, the test boring has indicated a layer of dense gravel till at five feet below MLW. If such material is encountered, it will tend to reduce the dredging rates.

17. Under normal conditions, a productivity of 5,000 (30% downtime) cubic yards can be achieved by a dredge with a 6 cubic yard clamshell bucket. This 5,000 cubic yard valve assumes a 60 second cycle time and accounts for 30 percent downtime for maintenance, moving from the channel to allow ships to pass, and other standard interruptions of normal operations. Based on the need to work the tide levels and the possibility of encountering gravel, a productivity of 2,000 yards per day has been estimated for this project. Tables D-1 and D-2 show the estimated cost per cubic yard for dredging in the Island End River.

TABLE 4-1
DREDGING COSTS
(Based on 6 days/week - 3 shifts per day)

WAGES:

Dredge	8500
Tending Boat	4300
Welder	100
3 Rodmen	1700
Boat 1	7500
2 Scowmen	1600
Subtotal	$ 23,700
(Insurance and Benefits) X 1.5	
Subtotal	$ 35,550

EQUIPMENT:

Dredge	8600
Tending Boat	4000
Boat 1	6800
2 Scows	10000
Miscellaneous	300
Outboard	200
Office	3000
Subtotal	$ 32,900

SUBSISTENCE:	$ 1300
Subtotal	$ 69,750
(Profit & Overhead)	X 1.2
TOTAL	$ 83,700 (Per Week)

COST PER CUBIC YARD

$\frac{\$83,700}{\text{week}}$ 6 days/week = $13,950/day

Assuming 2,000 cubic yards/day

$\frac{\$13,950\text{/day}}{2,000 \text{ cubic yards/day}}$ = $6.98/yard or SAY $7.00/yard

NOTE: Mobilization/Demobilization costs are not included in the above estimate. These costs are estimated at $25,000 (Lump Sum). Additional per yard costs for Mobilization/Demobilization are equal to $25,000/total yards.

TABLE 4-2

ESTIMATED DREDGING COSTS PER CUBIC YARD
INCLUDING COSTS OF MOBILIZATION/DEMOBILIZATION

TOTAL MOBILIZATON/DEMOBILIZATION COST = $25,000

	Amount of Dredging Cu. Yds.	Additional Mob/Demob. Cost Per Yd.	Estimated Total Cost Per Yd.
Plan A	52,000	$0.48	$7.50
Plan B	64,000	$0.39	$7.40
Plan C	90,000	$0.28	$7.30
Plan D	110,000	$0.23	$7.25

SECTION E
MAINTENANCE DREDGING

18.. Following initial dredging, the channel will tend to shoal or fill in, over time. Thus, periodic maintenance dredging will be required to preserve the desired channel depth. Shoaling of the channel will occur for two reasons:

- Settlement of side slopes
- Deposition of sediments from upland runoff

19. Although channel side slopes will be designed in such a way to enhance long term stability, changes in the bottom contours will occur over time resulting in gradually flattening of the slopes. Strong wave or current action occurring during storms may result in the movement of bottom sediments of a silty nature. The propeller wash produced by tugs and wakes of passing boats will also tend to disturb the river bottom, resulting in redistribution of material.

20. The river will also tend to shoal due to settling of solids carried into the river by storm drainage. The culverts which empty into the upstream end of the Island End River carry drainage from an area of approximately 2 square miles.

21. Portions of this drainage area consist of unpaved streets and parking areas, railroad yards, industrial sites and undeveloped areas. Those sites which are not paved or protected by vegetation, could contribute sediments to the stormwater runoff, despite the fact that the area is generally flat.

22. Erosion of the banks of the river will also tend to contribute to sedimentation of the river. At the present time, portions of the Chelsea shoreline exhibit erosion problems. Because both the tidal and downstream flow currents in the river are quite slack, sediments washing into the river will tend to settle on the bottom rather than being carried out of the river basin.

23. In order to estimate the rate of shoaling in the river, hydrographic surveys taken in 1979 were compared to surveys taken in 1975. Cross-sections from each survey were plotted and estimates were made of the net quantity of material that had settled in the river bottom. This analysis indicated that over a four year period 79,000 cubic feet of material was deposited over an area of 255,000 square feet. This indicates a shoaling rate of approximately 1" per year.

24. This shoaling rate, however, underestimates the rate at which shoaling will occur in a newly dredged channel. In addition, the 1975 hydrographic survey covered only the lower part of the river. The comparison of the two surveys and the calculated shoaling rate is therefore based only on that part of the river. More rapid shoaling is likely to take place in the upper part of the river where sediments from runoff will be deposited.

25. For the purposes of the cost estimates, an annual shoaling rate equal

to 4% of the initial dredged volume has been used. Based on a 6 foot channel depth, this rate would mean a decreace in channel depth by approximately 2-1/2 inches per year. Based on this rate, the one foot overdredge would be eliminated in about 5 years. Therefore, maintenance

?

TABLE 4-3

MAINTENANCE DREDGING COSTS

Plan B

Annual Amount	=	2600 c.y.
Amount in 5 years	=	13,000 c.y.

ASSUMING AN EFFICIENCY OF 80%

5,000 c.y./day X .80	=	4,000 c.y./day
12,000 c.y./4,000c.y./day	=	3.2 days

4 days X $14,000/day	=	$56,000
+ Mob/Demob.		25,000
		$81,000

$81,000 ÷ 13,000 c.y.	=	$6.23/c.y.
5.45 X 1.3	=	8.10
SAY		$8.00/c.y.

APPENDIX 5

CULTURAL AND NATURAL RESOURCES

SECTION A

DATA AND INTERPRETATION OF BENTHIC MACROINVERTEBRATE SAMPLES ISLAND END RIVER CHELSEA, MASSACHUSETTS AND SOURCES OF WATER QUALITY DATA BOSTON HARBOR

NEW ENGLAND RESEARCH, INC.
15 SAGAMORE ROAD
WORCESTER, MASSACHUSETTS 01605
TELEPHONE: (617) 7520346

SUBMITTED TO

STORCH ASSOCIATES
TWO CHARLESGATE WEST
BOSTON, MASSACHUSETTTS 02215

JULY 24, 1979

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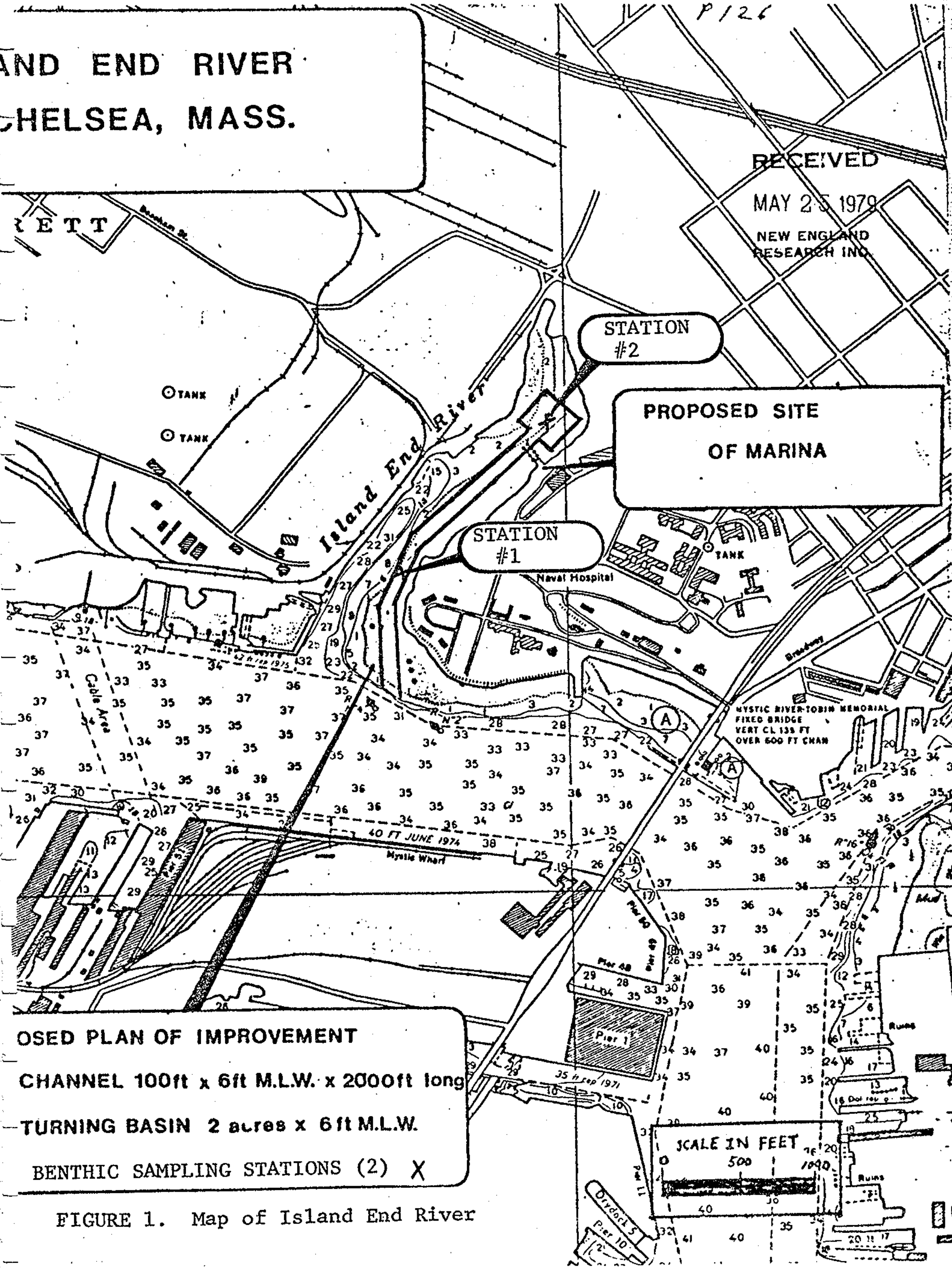

FIGURE 1. Map of Island End River

1. BENTHIC MACROINVERTEBRATE SAMPLES

A. Methods

Ten samples of the bottom sediments of the Island End River were collected with an Ekman dredge on May 30, 1979. Samples numbered 01 through 05 were collected at Station 1 in the proposed channel while samples numbered 06 through 10 were collected at Station 2 in the proposed turning basin. At each Station, the 5 samples were collected within a 20 foot diameter circle. Station locations are indicated in Figure 1, Map of Island End River.

Samples were returned to the laboratory for the separation, identification and counting of benthic macroinvertebrates. Methods used are detailed in APHA *et al.*, 1976, *Standard Methods for the Examination of Water and Wastewater* and in Weber, I.C., 1973, *Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents*.

B. Data

The identification and population density (number per square foot) of the benthic macroinvertebrates found in each sample are given in the following data sheets.

BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	2320
Capitellidae	1872
Spionidae (Polydora)	496
Phyllodocidae	4
Sabellidae	16
Oweniidae	0
Other	4
Nematoda	8
Turbellaria	36
Hydrozoa	0
Crustacea Amphipoda	8
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	4764

STATION NO. 1 , SAMPLE NO. 01

NEW ENGLAND RESEARCH, INC.
WORCESTER, MASSACHUSETTS
Project 126

BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	3152
Capitellidae	1752
Spionidae (Polydora)	760
Phyllodocidae	0
Sabellidae	16
Oweniidae	0
Other	16
Nematoda	256
Turbellaria	16
Hydrozoa	0
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	5968

STATION NO. 1 , SAMPLE NO. 02

NEW ENGLAND RESEARCH, INC.
WORCESTER, MASSACHUSETTS
Project 126

BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	2648
Capitellidae	1024
Spionidae (Polydora)	320
Phyllodocidae	8
Sabellidae	0
Oweniidae	24
Other	0
Nematoda	40
Turbellaria	0
Hydrozoa	0
Crustacea Amphipoda	0
Mollusca Bivalvia	8
TOTAL BENTHIC ORGANISMS	4072

STATION NO. 1 , SAMPLE NO. 03

NEW ENGLAND RESEARCH, INC.
WORCESTER, MASSACHUSETTS
Project 126

BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	2688
Capitellidae	2272
Spionidae (Polydora)	544
Phyllodocidae	16
Sabellidae	0
Oweniidae	0
Other	0
Nematoda	80
Turbellaria	16
Hydrozoa	0
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	5616

STATION NO. 1 , SAMPLE NO. 04

NEW ENGLAND RESEARCH, INC.
WORCESTER, MASSACHUSETTS
Project 126

BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	2016
Capitellidae	2768
Spionidae (Polydora)	752
Phyllodocidae	32
Sabellidae	0
Oweniidae	0
Other	0
Nematoda	368
Turbellaria	0
Hydrozoa	0
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	5936

STATION NO. 1 , SAMPLE NO. 05

NEW ENGLAND RESEARCH, INC.
WORCESTER, MASSACHUSETTS
Project 126

BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	2800
Capitellidae	5152
Spionidae (Polydora)	352
Phyllodocidae	48
Sabellidae	272
Oweniidae	0
Other	0
Nematoda	16
Turbellaria	16
Hydrozoa	48
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	8704

STATION NO. 2 , SAMPLE NO. 06

NEW ENGLAND RESEARCH, INC.
WORCESTER, MASSACHUSETTS

Project 126

BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	1984
Capitellidae	12320
Spionidae (Polydora)	80
Phyllodocidae	0
Sabellidae	208
Oweniidae	0
Other	1
Nematoda	0
Turbellaria	16
Hydrozoa	240
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	14849

STATION NO. 2 , SAMPLE NO. 07

NEW ENGLAND RESEARCH, INC.
WORCESTER, MASSACHUSETTS
Project 126

BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	800
Capitellidae	11296
Spionidae (Polydora)	48
Phyllodocidae	0
Sabellidae	0
Oweniidae	0
Other egg case	(16)
Nematoda	64
Turbellaria	16
Hydrozoa	48
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	12272

STATION NO. 2 , SAMPLE NO. 08

NEW ENGLAND RESEARCH, INC.
WORCESTER, MASSACHUSETTS
Project 126

BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	2240
Capitellidae	8640
Spionidae (Polydora)	64
Phyllodocidae	0
Sabellidae	32
Oweniidae	0
Other	0
Nematoda	0
Turbellaria	0
Hydrozoa	80
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	11056

STATION NO. 2 , SAMPLE NO. 09

NEW ENGLAND RESEARCH, INC.
WORCESTER, MASSACHUSETTS
Project 126

BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	928
Capitellidae	13216
Spionidae (Polydora)	32
Phyllodocidae	0
Sabellidae	16
Oweniidae	0
Other (egg cases)	(64)
Nematoda	32
Turbellaria	0
Hydrozoa	32
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	14256

STATION NO. 2 , SAMPLE NO. 10

NEW ENGLAND RESEARCH, INC.
WORCESTER, MASSACHUSETTS
Project 126

C. Interpretation

The populations of organisms found in the ten samples are typical of those found in polluted marine ecosystems. Noteable characteristics of these populations are the relatively high density of polychaete worms and the absence or low density of many other forms including molluscs and crustaceans.

A comparison of samples from Station 1 (Samples 01-05) with samples from Station 2 (Samples 06-10) indicates a much higher density of Capitellidae at Station 2. The Capitellidae are polychaete worms which tend to be pollution tolerant, indicating that a somewhat more polluted situation, exists at the upstream station.

The close agreement between samples at a given station indicates that fairly uniform habitat conditions exist in the bottom sediments. At Station 1, the total number of organisms ranged from about 4000 to 6000 per square foot. At Station 2 the total number of organisms ranged from about 9000 to 15,000 per square foot, indicating more variation in these samples.

Visual examination of the sediments in the laboratory indicated that all samples were composed predominantly of a very fine-textured (probably silt to clay size), black, oily sediment. Samples 01 through 05 contained some small rocks. Samples 06 through 10 contained few or no rocks, but did contain parts of leaves, twigs and other fiberous organic matter. No chemical or physical analyses were performed on any of these samples.

2. LIST OF SOURCES OF WATER QUALITY DATA FOR BOSTON HARBOR

This list consists of two parts. The first part is a bibliographic list of reports and other documents along with a parenthetical note on the agency or company where they may be obtained or reviewed. The second part is a list of addresses of these agencies or companies.

A. Bibliographic List

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Verter Corporation. July 1976. Phase I Final Report on Greater Boston: Water-Quality Issues in Planning for Pollution Control. McLean, Virginia.

B. Address List

Boston Edison Company
800 Boylston Street
Boston, Massachusetts 02113

Boston Harbor Associates
70 Long Wharf
Boston, Massachusetts 02110

(BRA) Boston Redevelopment Authority
City Hall
1 City Hall Square
Boston, Massachusetts 02201

(EPA Region 1) United States Environmental Protection Agency
John F. Kennedy Federal Building, Government Center
Boston, Massachusetts 02203

(MAPC) Metropolitan Area Planning Council
44 School Street
Boston, Massachusetts 02108

(MDC) Metropolitan District Commission
20 Somerset Street
Boston, Massachusetts 02108

(MDWPC) Massachusetts Division of Water Pollution Control
Laverett Saltonstall Building
100 Cambridge Street
Boston, Massachusetts 02202

MIT Press
28 Carleton
Cambridge, Massachusetts 02138

(NEA) New England Aquarium
Central Wharf
Boston, Massachusetts 02110

(NTIS) National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA. 22151

Woods Hole Oceanographic Institution Library
Woods Hole,
Massachusetts 02543

SECTION B

ECOLOGICAL EVALUATION OF PROPOSED OCEANIC DISCHARGE OF DREDGED MATERIAL FROM ISLAND END RIVER, CHELSEA, MASSACHUSETTS

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Cambridge, Massachusetts 02138

May 1, 1979

ACKNOWLEDGEMENTS

This report was written by Dr. Curt D. Rose, Principal Aquatic Ecologist, Energy Resources Company Inc. (ERCO). Mr. Timothy J. Ward, Aquatic Toxicologist, ERCO, observed collection of dredged material, prepared material and water for bioassays (toxicity tests), and conducted bioassays.

SUMMARY

The proposed oceanic discharge of dredged material from Island End River, Chelsea, Massachusetts is ecologically unacceptable as judged by several bioassay-related criteria employed in this investigation. Survival of the copepod (*Acartia tonsa*), mysid shrimp (*Mysidopsis bahia*), and Atlantic silverside (*Menidia menidia*) exposed for 96 hr to culture water control and 100% liquid phase of three samples of dredged material is not, with one exception, significantly different (P = 0.05). Mysid shrimp exposed to 100% liquid phase of Dredged Material - Sample C did exhibit significantly lower (P = 0.01) survival than control animals, but exposure-time-dependent limiting permissible concentrations (LPC's) for the liquid phase of that sample are greater than the environmental concentration of the phase after initial mixing. Survival of the above-identified species exposed for 96 hr to culture water control and 100% suspended particulate phase of the three samples of dredged material is not significantly different. However, total (combined) survival of the mysid shrimp (*Neomysis americana*), hard clam (*Mercenaria mercenaria*), and sandworm (*Nereis virens*) exposed for 10 days to control (reference) sediment and the solid phase of the three samples of dredged material is significantly different (P = 0.01). Moreover, this difference in survival is, at least in part, attributable to differences between the control sediment and all samples of dredged material. In addition, the mean magnitude of each of these differences is greater than 10%.

The conclusion that dredged material from Island End River is ecologically unacceptable for oceanic disposal is based solely on the low survival that characterized mysid shrimp exposed to the solid phase of the material. Similarly low survival may be experienced by shrimp exposed to sediment

from the vicinity of the proposed disposal site. In this eventuality, oceanic disposal of the dredged material would be judged to be ecologically acceptable. Therefore, we recommend that solid phase bioassays of the dredged material be conducted with a disposal-site-sediment control as well as a "culture-sediment" control.

TABLE OF CONTENTS

1. INTRODUCTION

The major objective of the investigation described in this report is to evaluate the ecological acceptability of the proposed oceanic discharge of dredged material from Island End River, Chelsea, Massachusetts (Figure 1). If the proposed discharge is judged to be ecologically acceptable according to the bioassay-related criteria employed in the investigation, the disposal practice is considered to be in partial compliance with Subpart B (Environmental Impact) of the ocean dumping regulations (Fed. Reg., 1977).

Subpart B (Environment Impact) of the ocean dumping regulations consists of the following basic sections: §227.5 (Prohibited Materials); §227.6 (Constituents Prohibited as Other than Trace Contaminants); §227.7 (Limits Established for Specific Wastes or Waste Constituents); §227.8 (Limitations on the Disposal Rates of Toxic Wastes); §227.9 (Limitations on Quantities of Waste Materials); §227.10 (Hazards to Fishing, Navigation, Shorelines or Beaches); §227.11 (Containerized Wastes); and §227.13 (Dredged Materials). Disposal of dredged material must comply with restrictions and limitations imposed by §227.5, §227.6, §227.9, §227.10, and §227.13 of the regulations (Fed. Reg., 1977).

This investigation addresses only §227.6 (Constituents Prohibited as Other than Trace Contaminants) and §227.13 (Dredged Materials) of the ocean dumping regulations. However, it is important to note that full compliance with even these sections is not evaluated in the study. Section 227.13, by its reference in ¶(c)(3) to ¶(b) of §227.27, requires that the potential for bioaccumulation, as well as the toxicity, of the suspended particulate and solid phases of dredged

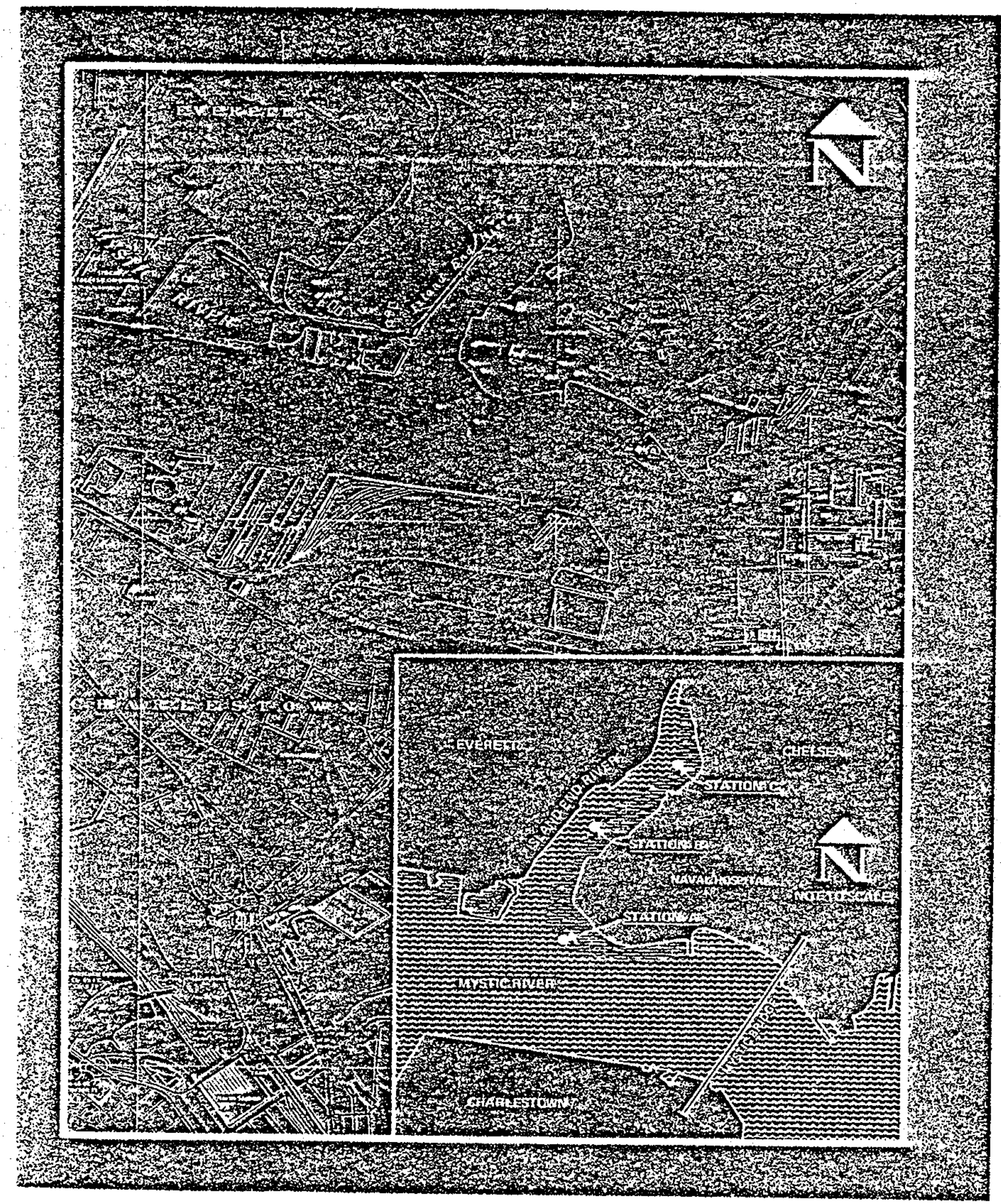

Figure 1. Location of dredging site. Sampling stations for dredged material are schematically depicted in inset.

material be considered. §227.6 also requires a consideration of the potential of the suspended particulate and solid phases of wastes to bioaccumulate (in §227.6, emphasis is placed on the use of bioassay organisms to assess the potential for bioaccumulation). In addition, §227.6 mandates a bioassay-based evaluation of the bioaccumulation potential of the liquid phase of a waste if the waste contains persistent organohalogens that are not included in marine water quality criteria (¶[c][4] of §227.6). Also, §227.6 contains a provision (¶[c][1]) that requires constituents of the liquid phase to be compared to applicable marine water quality criteria. Bioaccumulation and "water-quality-criteria" studies were not conducted as part of the investigation.

This report consists of five principal sections in addition to the Introduction. The first section, which precedes the Introduction, summarizes the ecological acceptability of the proposed discharge operation. The second section reviews the methods and materials employed in the investigation. The third section presents important results of the investigation. The fourth section is a discussion of the scientific credibility of several protocols utilized in the investigation. The last section lists references cited in the report.

The report contains two appendices. Appendix A details laboratory procedures employed for preparing dredged material and conducting bioassays. The appendix also serves as a quality-control document. Appendix B contains all raw bioassay-related data. Only data directly relevant to the ecological evaluation of the potential discharge operation are presented in the main body of the report.

2. METHODS AND MATERIALS[1]

Dredged material was collected from three stations in Island End River (Figure 1) during 0900-1100 on March 29, 1979. Material was collected from a commercial fishing vessel by representatives of the New England Division of the Corps of Engineers (supervisor was Mr. Roy S. Clark). Mr. Timothy J. Ward, Aquatic Toxicologist at Energy Resources Company Inc. (ERCO), observed the collection efforts.

Station A was located near the mouth of the river at approximately 1,000 m from the river's eastern shore. Depth of water at the station was about 2-3 m. Station B was situated upriver from Station A and approximately 500 m from the eastern shore of the river (depth of water was about 1-2 m). Station C was located upriver from Station B and approximately 500 m from the eastern shore (water depth was about 1-2 m). At each station, approximately 8-12 samples of dredged material were collected with a Van Veen grab after the fishing vessel had been anchored. Each set of samples was distributed into five 15-l bags, which were assigned identification numbers (Station A: GEB-1-79; Station B: GEB-2-79; Station C: GEB-3-79). The bags were transported immediately to ERCO's Bioassay Laboratory in Cambridge, Massachusetts. Bags were put into cold storage (2-4° C) at the laboratory at 1300 on March 29, 1979.

Dredged material was prepared for biological testing according to procedures described in Appendix B of the manual entitled Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters (U.S. EPA/U.S. COE, 1977).

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[1]Laboratory procedures used to prepare dredged material and conduct bioassays are described in detail in Appendix A of this report.

Artificial seawater (30 ppt salinity) was employed to formulate liquid and suspended particulate phases of the dredged material (disposal-site water was not used because a proposed disposal site for the material had not been identified). During preparation of the liquid and suspended particulate phases, dredged material and artificial seawater were mixed by mechanical methods (as opposed to mixing by compressed air) since anoxic conditions did not occur in the sediment-seawater mixtures. In preparation of the liquid phase, centrifugation was not required to reduce concentrations of suspended solids prior to filtration.

Bioassays with dredged material were, with one exception, conducted according to guidelines presented in Appendices D and F of the EPA/COE manual for dredged material (U.S. EPA/U.S. COE, 1977). The one exception is that 19-l aquaria, rather than 38-l aquaria, were used to conduct liquid and suspended particulate phase bioassays with fishes. The use of the smaller aquaria is sanctioned by the EPA in its contemporary procedures for performing bioassays for the Ocean Dumping Permit Program (U.S. EPA, 1978).

Species employed in the liquid and suspended particulate phase bioassays were the copepod (*Acartia tonsa*), mysid shrimp (*Mysidopsis bahia*), and Atlantic silverside (*Menidia menidia*). The animals were purchased from Sea Plantations, Inc., Salem, Massachusetts. Bioassays were conducted at $20 \pm 1°$ C, the recommended summer testing temperature for the New England region (U.S. EPA/U.S. COE, 1977). Since a proposed disposal site was not identified, artificial seawater was used to dilute liquid and suspended particulate phases to appropriate test concentrations and as the single control (culture water control).

Species tested in the solid phase bioassays were the mysid shrimp (Neomysis americana), hard clam (Mercenaria mercenaria, and sandworm (Nereis virens). All species were tested in the same aquaria. Source of animals and test temperature were the same as in the liquid and suspended particulate phase bioassays. Reference sediment was obtained from the intertidal zone of southern Massachusetts Bay and consisted primarily of sand. Water exchange (artifical seawater) during the bioassays was by the replacement, as compared to the flow-through, method.

During all bioassays, mysid shrimp were fed live 48-hr-old Artemia (brine shrimp) nauplii at a rate of approximately 1 ml of culture/200-ml crystallizing dish/day (liquid and suspended particulate phase tests) or 10 ml of culture/38-l aquarium/day (solid phase tests).

The environmental concentration of the liquid phase of Dredged Material - Sample C after the 4-hr period of initial mixing was estimated by the release-zone method (U.S. EPA/ U.S. COE, 1977; Appendix H). Volume of the initial mixing zone (V_m) was determined by the equation for instantaneous discharge of dredged material or discharge from a stationary vessel:

$$V_{m_{(m^3)}} = \pi(100)^2 d + 200wd + (200 + w)\ell d, \qquad \text{(Equation 1)}$$

with d (depth of mixing zone), w (width of disposal vessel), and ℓ (length of disposal vessel) assumed to be 20 m, 18 m, and 60 m, respectively. Thus, $V_m = 961{,}920\ m^3$. Volume of the discharged liquid phase (V_w) was determined by the equation:

$$V_{w_{(m^3)}} = \frac{P_b - P_d}{P_w - P_d}\,(V_T), \qquad \text{(Equation 2)}$$

with P_b (bulk density), P_d (particle density), P_w (liquid phase density), and V_T (volume of disposal vessel) assumed to be 1.5, 2.6, 1.0, and 3,058 m^3, respectively. Therefore, V_w = 2,102 m^3. Environmental concentration of the liquid phase after initial mixing (C_w) was calculated by the equation:

$$C_{w(\%)} = \frac{V_w}{V_m} (100) = \frac{2,102 \text{ m}^3}{961,920 \text{ m}^3} (100) = 0.22\% \qquad \text{(Equation 3)}$$

3. RESULTS

The three samples of dredged material employed in the investigation were characterized by physical differences. Sample A consisted primarily of sand, gravel, large rocks, and pieces of shells. The sample was black and contained traces of oil. Sample B was similar in characteristics to Sample A except that it contained more mud and less coarse material. Sample C consisted of black mud and large amounts of oil. No living organisms were observed in any of the samples.

3.1 Liquid and Suspended Particulate Phase Bioassays

Results of liquid and suspended particulate phase bioassays are presented according to the same format since analyses of both types of tests are based on identical components (U.S. EPA/U.S. COE, 1977): (1) selection of an appropriate control for comparison to test results (when disposal-site water as well as culture water is used for control purposes), (2) preliminary comparison of survival of animals exposed for 96 hr to the appropriate control and 100% liquid/suspended particulate phase, (3) calculation or estimation of exposure-time-dependent LC50's (median lethal concentrations) and associated 0.95 confidence intervals for the liquid/suspended particulate phase (if survival in 100% liquid/suspended particulate phase is significantly less [in a statistical sense] than survival in the appropriate control), (4) derivation of exposure-time-dependent limiting permissible concentrations (LPC's) for the liquid/suspended particulate phase by multiplying lower limits of the 0.95 confidence intervals of the LC50's for the phase by 0.01 or a pragmatically determined application factor, and (5) graphical comparison of the LPC's for the liquid/suspended particulate phase to estimated environmental concentrations ("dilution curve") of the phase as determined, in all probability, by the "release zone method."

3.1.1 Liquid Phase Bioassays

Data generated by liquid phase bioassays with the copepod, mysid shrimp, and Atlantic silverside are presented in, respectively, Tables B1, B2, and B3 (Appendix B). The silverside was the most resistant of all species to the liquid phase (all but one fish survived the bioassays). Mean survival rates for copepods and mysid shrimp exposed for 96 hr to 100% liquid phase were 53.3-60.0% and 63.3-96.7%, respectively. In most bioassays with copepods and shrimp, the liquid phase appeared to exert a noncumulative effect, i.e., mortality pattern of organisms had stabilized by the end of the 96-hr testing period.

Analyses of survival data for the copepod, mysid shrimp, and Atlantic silverside exposed for 96 hr to culture water control and 100% liquid phase of dredged material are presented in Tables 1-3, respectively. In the case of all species, survival in the control test was equal to or greater than 90%, thus permitting further analyses of data. Survival data for the copepod (Table 1) exhibited homogeneity of variances, as judged by Cochran's test. Thus, a one-way parametric analysis of variance (ANOVA) with nontransformed data was employed to determine if data are characterized by significant differences (the "t" test described in ¶25, Appendix D of the EPA/COE manual for dredged material [U.S. EPA/U.S. COE, 1977] is not appropriate for use with more than one sample of dredged material and a control). Results of

Table 1. Analysis of survival data for the copepod, *Acartia tonsa*, exposed for 96 hr to culture water control and 100% liquid phase of dredged material

Step 1. Survival Data (From Table B1)

Replicate (r)	Treatment (t): Culture Water Control	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
	Number of Survivors			
1	9	4	5	3
2	8	8	5	9
3	10	4	8	6
Mean ($\bar{x}$):	9.00 (90.0%)	5.33 (53.3%)	6.00 (60.0%)	6.00 (60.0%)

Step 2. Cochran's Test for Homogeneity of Variances of Survival Data

Treatment (t)	Number of Survivors Mean ($\bar{x}$)	Variance(s^2)
Culture Water Control	9.00	1.00
Dredged Material - Sample A	5.33	5.34
Dredged Material - Sample B	6.00	2.99
Dredged Material - Sample C	6.00	9.00

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{9.00}{18.33} = 0.49 \text{ ns,}$$

as compared to: $C_{(tab.)} = 0.77$ for $P = 0.05$, $k = 4$, and $v = 2$

Step 3. One-Way Parametric Analysis of Variance (ANOVA) of Survival Data

Source of Variation	df	Sum of Squares	Mean Square	$F_{(cal.)}$	
Treatment (Culture Water Control, Dredged Material - Sample A, Dredged Material - Sample B, Dredged Material - Sample C)	t-1=3	24.25	8.08	1.76 ns,	as compared to $F_{(tab.)}$ = 4.07 for P = 0.05, numerator df = 3, and denominator df = 8
Error	t(r-1)=8	36.67	4.58		
Total	tr-1=11	60.92			

Table 2. Analysis of survival data for the mysid shrimp, Mysidopsis bahia, exposed for 96 hr to culture water control and 100% liquid phase of dredged material

Step 1. Survival Data (From Table B2)

Replicate (r)	Treatment (t): Culture Water Control	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
	Number of Survivors			
1	10	10	9	5
2	10	9	9	8
3	9	10	10	6
Mean ($\bar{x}$):	9.67 (96.7%)	9.67 (96.7%)	9.33 (93.3%)	6.33 (63.3%)

Step 2. Cochran's Test for Homogeneity of Variances of Survival Data

Treatment (t)	Number of Survivors: Mean ($\bar{x}$)	Variance(s^2)
Culture Water Control	9.67	0.33
Dredged Material - Sample A	9.67	0.33
Dredged Material - Sample B	9.33	0.33
Dredged Material - Sample C	6.33	2.34

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{2.34}{3.33} = 0.70 \text{ ns},$$

as compared to: $C_{(tab.)} = 0.77$ for $P = 0.05$, $k = 4$, and $v = 2$

Step 3. One-Way Parametric Analysis of Variance (ANOVA) of Survival Data

Source of Variation	df	Sum of Squares	Mean Square	$F_{(cal.)}$	
Treatment (Culture Water Control, Dredged Material - Sample A, Dredged Material - Sample B, Dredged Material - Sample C)	t-1=3	23.58	7.86	9.47**,	as compared to $F_{(tab.)}$ = 7.59 for P = 0.01, numerator df = 3, and denominator df = 8
Error	t(r-1)=8	6.67	0.83		
Total	tr-1=11	30.25			

Step 4. It is apparent without further statistical analysis that the source of the significant difference in survival data is Dredged Material - Sample C (see survival data presented in Step 1).

Table 3. Analysis of survival data for the Atlantic silverside, *Menidia menidia*, exposed for 96 hr to culture water control and 100% liquid phase of dredged material

Step 1. Survival Data (From Table B3)

Replicate (r)	Treatment (t): Culture Water Control	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
	Number of Survivors			
1	10	10	10	10
2	10	10	10	10
3	10	10	10	10
Mean ($\bar{x}$):	10.00 (100.0%)	10.00 (100.0%)	10.00 (100.0%)	10.00 (100.0%)

Step 2. There are no differences in survival of animals exposed to culture water control and 100% liquid phase of dredged material. Therefore, further statistical analysis is unnecessary.

the ANOVA indicate no statistically significant differences ($P = 0.05$) in survival of animals exposed to culture water control and 100% liquid phase of dredged material. Therefore, it is concluded that, in terms of its effect on the copepod, the liquid phase is ecologically acceptable for oceanic discharge.[1]

Survival data for the mysid shrimp (Table 2) also exhibit homogeneity of variances, thereby allowing the use of a one-way parametric ANOVA with nontransformed data for further analysis. The ANOVA identifies a real difference ($P = 0.01$) in survival of animals exposed to culture water control and 100% liquid phase of dredged material, and perusal of the survival data indicates that the source of this difference is the relatively low survival experienced by animals exposed to 100% liquid phase of Dredged Material - Sample C. However, exposure-time-dependent LPC's for the liquid phase of Dredged Material - Sample C are greater than the environmental concentration of the liquid phase of the sample after initial mixing (Figure 2). (Each LPC is the product of a 0.01 application factor [Fed. Reg., 1977] and a minimum estimate of the LC50 since the relatively high survival (>50%) of animals exposed for 96 hr to 100% liquid phase of the sample precludes the calculation of "real" LC50's and associated 0.95 confidence intervals.) Thus, it is concluded that, with regard to its effect on the mysid shrimp, the liquid phase is ecologically acceptable for oceanic discharge.

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[1]Paragraph 28, page D13, Appendix D of the EPA/COE manual for dredged material (U.S. EPA/U.S. COE, 1977) specifies that "when no differences are detected between control and test survival after 96 hr, the analysis may be considered complete at this point with no indication of potential impact of the liquid (or suspended particulate) phase if the proposed disposal operation occurs." Thus, further analyses relating to LC50's and associated confidence intervals, LPC's, and environmental concentrations of the phase are not warranted.

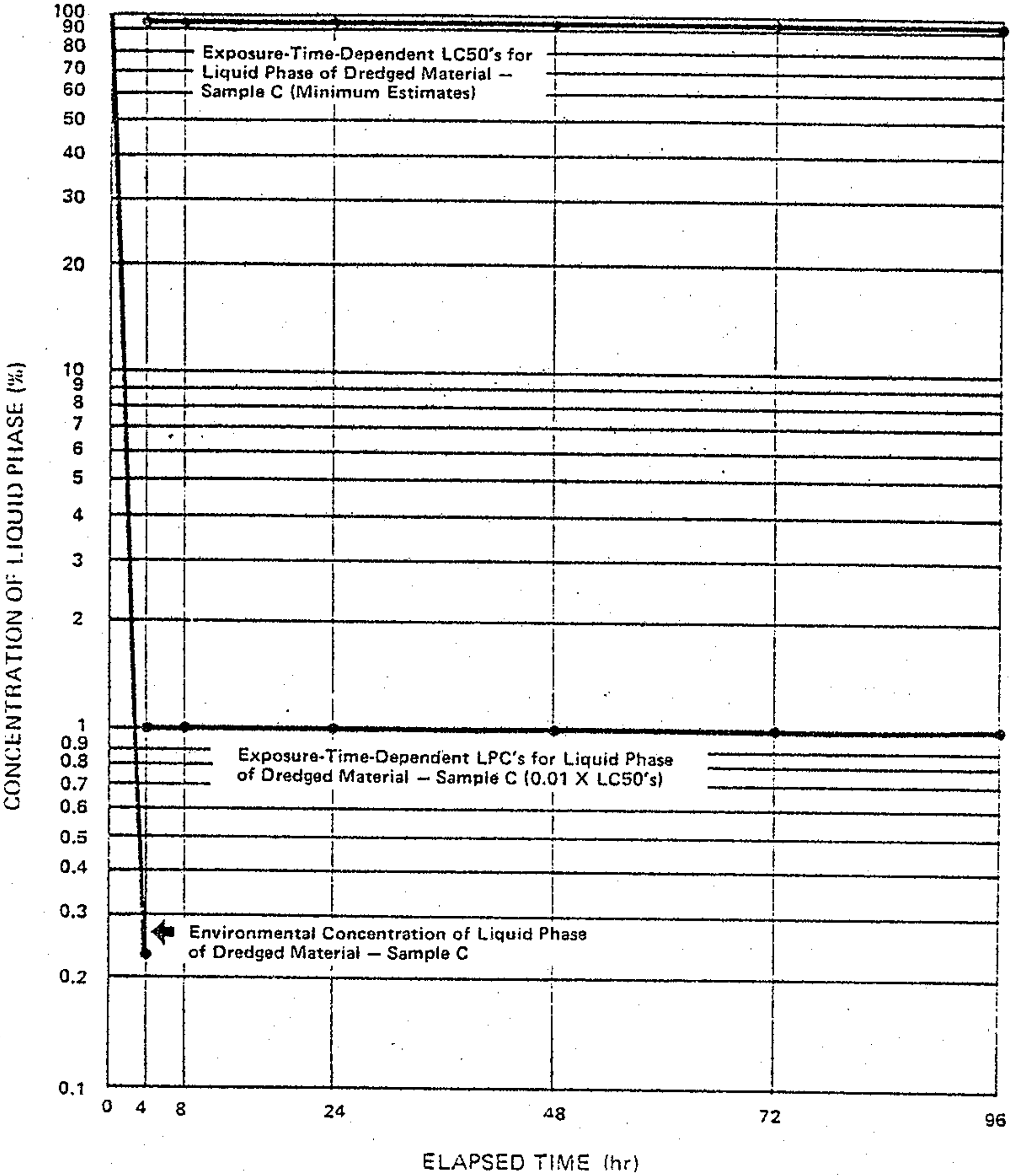

Figure 2. Comparison of exposure-time-dependent limiting permissible concentrations (LPC's) for liquid phase of Dredged Material — Sample C (tested with the mysid shrimp, *Mysidopsis bahia*) and environmental concentration of the liquid phase after initial mixing. Environmental concentration of the liquid phase after initial mixing (the 4-hr period immediately following discharge of dredged material) was estimated by the release-zone method (U.S. EPA/U.S. COE, 1977).

Survival data for the Atlantic silverside (Table 3) exhibit no variation (survival was 100% in all cases). Consequently, it can be concluded without further statistical analyses that, in terms of its effect on the silverside, the liquid phase is environmentally acceptable for oceanic disposal.

3.1.2 Suspended Particulate Phase Bioassays

Data produced by suspended particulate phase bioassays with the copepod, mysid shrimp, and Atlantic silverside are presented in, respectively, Tables B4, B5, and B6 (Appendix B). As in the case of the liquid phase, the silverside was the most resistant of all species to the test material (all fish survived the bioassays). Mean survival rates of copepods and mysid shrimp exposed for 96 hr to 100% suspended particulate phase were 50.0-56.7% and 50.0-76.7%, respectively. Mortality patterns of copepods and shrimp usually had not stabilized by the end of the testing period.

Analyses of survival data for the copepod and mysid shrimp exposed for 96 hr to culture water control and 100% suspended particulate phase of dredged material are presented in Tables 4 and 5, respectively. For both species, survival of animals exposed to culture water control was greater than 90%, thereby allowing further analyses of data. These analyses indicate that both sets of data exhibit homogeneous variances (Cochran's test) and that survival of animals exposed to culture water control and 100% suspended particulate phase of dredged material is not significantly different at $P = 0.05$ (one-way parametric ANOVA). Thus, it is concluded that the suspended particulate phase is ecologically acceptable for discharge to the ocean.

Table 4. Analysis of survival data for the copepod, *Acartia tonsa*, exposed for 96 hr to culture water control and 100% suspended particulate phase of dredged material

Step 1. Survival Data (From Table B4)

Replicate (r)	Treatment (t):	Culture Water Control	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
		Number of Survivors			
1		10	5	5	3
2		8	7	4	5
3		10	4	8	7
	Mean ($\bar{x}$):	9.33 (93.3%)	5.33 (53.3%)	5.67 (56.7%)	5.00 (50.0%)

Step 2. Cochran's Test for Homogeneity of Variances of Survival Data

Treatment (t)	Number of Survivors Mean ($\bar{x}$)	Variance(s^2)
Culture Water Control	9.33	1.32
Dredged Material - Sample A	5.33	2.34
Dredged Material - Sample B	5.67	4.33
Dredged Material - Sample C	5.00	4.00

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{4.33}{11.99} = 0.36 \text{ ns,}$$

as compared to: $C_{(tab.)} = 0.77$ for $P = 0.05$, $k = 4$, and $v = 2$

Step 3. One-Way Parametric Analysis of Variance (ANOVA) of Survival Data

Source of Variation	df	Sum of Squares	Mean Square	$F_{(cal.)}$	
Treatment (Culture Water Control, Dredged Material - Sample A, Dredged Material - Sample B, Dredged Material - Sample C)	t-1=3	36.67	12.22	4.07 ns,	as compared to $F_{(tab.)}$ = 4.07 for P = 0.05, numerator df = 3, and denominator df = 8
Error	t(r-1)=8	24.00	3.00		
Total	tr-1=11	60.67			

Table 5. Analysis of survival data for the mysid shrimp, *Mysidopsis bahia*, exposed for 96 hr to culture water control and 100% suspended particulate phase of dredged material

Step 1. Survival Data (From Table B5)

	Treatment (t):	Number of Survivors			
Replicate (r)		Culture Water Control	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
1		9	7	9	8
2		10	5	8	2
3		9	8	6	5
	Mean ($\bar{x}$):	9.33 (93.3%)	6.67 (66.7%)	7.67 (76.7%)	5.00 (50.0%)

Step 2. Cochran's Test for Homogeneity of Variances of Survival Data

Treatment (t)	Number of Survivors: Mean ($\bar{x}$)	Number of Survivors: Variance(s^2)
Culture Water Control	9.33	0.34
Dredged Material - Sample A	6.67	2.34
Dredged Material - Sample B	7.67	2.34
Dredged Material - Sample C	5.00	9.00

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{9.00}{14.02} = 0.64 \text{ ns,}$$

as compared to: $C_{(tab.)} = 0.77$ for $P = 0.05$, $k = 4$, and $v = 2$

Step 3. One-Way Parametric Analysis of Variance (ANOVA) of Survival Data

Source of Variation	df	Sum of Squares	Mean Square	$F_{(cal.)}$	
Treatment (Culture Water Control, Dredged Material - Sample A, Dredged Material - Sample B, Dredged Material - Sample C)	t-1=3	29.67	9.89	2.83 ns,	as compared to $F_{(tab.)}$ = 4.07 for P = 0.05, numerator df = 3, and denominator df = 8
Error	t(r-1)=8	28.00	3.50		
Total	tr-1=11	57.57			

Survival data for the Atlantic silverside (Table 6) again exhibit no variation (survival was always 100%). Therefore, it can be immediately concluded that the suspended particulate phase is environmentally acceptable for oceanic disposal.

3.2 Solid Phase Bioassays

Solid phase bioassays, unlike liquid and suspended particulate phase tests, are analyzed almost exclusively according to statistical techniques. The concepts of preliminary comparisons of survival of control and test animals, LC50's and related confidence intervals, quantitative LPC's, and models of environmental fate of discharged material are not applicable.

Data generated by solid phase bioassays with the mysid shrimp, hard clam, and sandworm are presented in Table B7 (Appendix B). Mean survival rates of hard clams and sandworms exposed to dredged material were relatively high, i.e., 91.0-94.0% for the clam and 93.0-96.0% for the worm. However, mean survial rate of mysid shrimp exposed to the material was low - 12.0-27.0%. Mortality of shrimp appeared to be at least partly associated with fouling of animals by fine particulate matter.

Analysis of total (combined) survival data for the three species exposed for 10 days to control (reference) sediment and solid phase of dredged material is presented in Table 7. Survival of control animals was greater than 90%, thus allowing further evaluation of data. Data exhibited homogeneous variances (Cochran's test), thereby permitting a one-way parametric ANOVA to be performed with nontransformed

Table 6. Analysis of survival data for the Atlantic silverside, *Menidia menidia*, exposed for 96 hr to culture water control and 100% suspended particulate phase of dredged material

Step 1. Survival Data (From Table B6)

	Number of Survivors			
Replicate (r) / Treatment (t):	Culture Water Control	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
1	10	10	10	10
2	10	10	10	10
3	10	10	10	10
Mean ($\bar{x}$):	10.00 (100.0%)	10.00 (100.0%)	10.00 (100.0%)	10.00 (100.0%)

Step 2. There are no differences in survival of animals exposed to culture water control and 100% suspended particulate phase of dredged material. Therefore, further statistical analysis is unnecessary.

Table 7. Analysis of total survival data for the mysid shrimp (*Neomysis americana*), hard clam (*Mercenaria mercenaria*), and sandworm (*Nereis virens*) exposed for 10 days to control (reference) sediment and solid phase of dredged material

Step 1. Total Survival Data (From Table B7)

Replicate (r)	Treatment (t): Control (Reference) Sediment	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
	Total Number of Survivors			
1	54	44	46	40
2	56	42	38	38
3	55	41	40	45
4	57	45	43	38
5	56	44	38	41
Mean ($\bar{x}$):	55.6 (92.7%)	43.2 (72.0%)	41.0 (68.3%)	40.4 (67.3%)

Step 2. Cochran's Test for Homogeneity of Variances of Total Survival Data

Treatment (t)	Number of Survivors: Mean ($\bar{x}$)	Variance (s^2)
Control (Reference) Sediment	55.6	1.30
Dredged Material - Sample A	43.2	2.69
Dredged Material - Sample B	41.0	12.00
Dredged Material - Sample C	40.4	8.29

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{12.00}{24.28} = 0.49 \text{ ns,}$$

as compared to: $C_{(tab.)} = 0.63$ for $P = 0.05$, $k = 4$, and $v = 4$

Step 3. One-Way Parametric Analysis of Variance (ANOVA) of Total Survival Data

Source of Variation	df	Sum of Squares	Mean Square	$F_{(cal.)}$	
Treatment (Control sediment, Dredged Material - Sample A, Dredged Material - Sample B, Dredged Material - Sample C)	t-1=3	763.75	254.58	41.87**,	as compared to $F_{(tab.)}$ = 5.29 for P = 0.01, numerator df = 3, and denominator df = 16
Error	t(r-1)=16	97.20	6.08		
Total	tr-1=19	860.95			

Table 7. (Continued)

Step. 4 Student-Newman-Keuls' Multiple-Range Test for Identifying Source(s) of Significant Difference(s) in Total Survival Data

A. Ranking of Treatment Means ($\bar{x}$) From Lowest to Highest

(1)	(2)	(3)	(4)
Dredged Material, Sample C - 40.4	Dredged Material, Sample B - 41.0	Dredged Material, Sample A - 43.2	Control (Reference) Sediment - 55.6

B. Comparison of Mean for Control (Reference) Sediment with Means for Dredged Material

Comparison of Means	Difference Between Means	
(4) versus (1)	55.6 - 40.4 = 15.2**,	as compared to LSD (least significant difference) = 5.71 for P = 0.01, $s_{\bar{x}}$ = 1.10, and K =4
(4) versus (2)	55.6 - 41.0 = 14.6**,	as compared to LSD = 5.26 for P = 0.01, $s_{\bar{x}}$ = 1.10, and K =3
(4) versus (3)	55.6 - 43.2 = 12.4**,	as compared to LSD = 4.54 for P = 0.01, $s_{\bar{x}}$ = 1.10, and K =2

data. The ANOVA indicates that survival of animals exposed to control sediment and dredged material is significantly different at P = 0.01. A subsequent test (Student-Newman-Keuls' multiple-range test) demonstrates that a source of this significant difference in survival is differences between animals exposed to control sediment and all samples of dredged material. In addition, the mean magnitude of each of these differences is greater than 10%. Therefore, it is concluded that the solid phase is ecologically unacceptable for discharge to oceanic waters.[1]

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[1]Paragraph 37, page F17, Appendix F of the EPA/COE manual for dredged material (U.S. EPA/U.S. COE, 1977) states that a solid phase has "real potential for causing environmentally unacceptable impacts on benthic organisms [only if] difference in mean survival between animals in the control and test sediments is statistically significant <u>and</u> [emphasis added] greater than 10 percent."

4. DISCUSSION

Results of the liquid phase bioassays with the copepod and the suspended particulate phase bioassays with the copepod and mysid shrimp demonstrate that a one-way parametric ANOVA sometimes does not indicate statistically significant differences (P = 0.05) in survival of animals exposed to culture water control and 100% liquid/suspended particulate phase of dredged material even when the differences appear to be substantial (in the case of the suspended particulate phase tests, survival of animals in 100% phase was almost low enough to allow calculation of LC50's). Several statistical techniques can be employed to increase the power (ability) of the ANOVA to detect real differences in survival between control and test animals, e.g., more than three replicates (samples) can be employed per treatment, criterion for declaring a difference to be significant can be changed from P = 0.05 to P = 0.10, and/or multiple-range or other appropriate tests can be used to compare control versus test survival even if the ANOVA does not signal the presence of such differences. Such statistical refinements, while desirable, would not alter the conclusions reached in this investigation concerning the ecological acceptability of the liquid and suspended particulate phases for oceanic disposal since, in all cases, the minimum LPC's for a phase are 1% (0.01 X 100% phase [the minimum estimate of the LC50's]) and the environmental concentration of a phase after intitial mixing is substantially less than the 1% value.

The most critical result of the solid phase bioassays is the low survival rate experienced by mysid shrimp exposed to dredged material. It is this low survival rate that, even when masked by the relatively high survival rate exhibited by the hard clam and sandworm, is the basis of the significant

($P = 0.01$) and large (>10%) differences in survival between control and test animals and, consequently, the conclusion that the dredged material is ecologically unacceptable for discharge to oceanic waters. It is likely that the poor survival of mysid shrimp is, in great part, attributable to fine particulate matter in the dredged material. For similar reasons, poor survival may be experienced by shrimp exposed to sediment from the vicinity of the proposed disposal site. In this eventuality, oceanic disposal of the dredged material would be judged to be ecologically acceptable. Therefore, we recommend that solid phase tests of the dredged material be conducted with a disposal-site-sediment control as well as a "culture-sediment" control.

We additionally recommend that future dredged-material evaluations be conducted with a large species, e.g., the grass shrimp, Palaemonetes sp., being substituted for the mysid shrimp in solid phase bioassays. Such a substitution would minimize the impact of particle size of sediments on test results and would allow an efficient assessment of the potential for bioaccumulation of constitutents of dredged material. Also, it is more scientifically correct to analyze all results of solid phase bioassays according to species than to perform the analyses for "grouped" species.

5. REFERENCES

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U.S. Environmental Protection Agency/U.S. Corps of Engineers. 1977. Ecological evaluation of proposed discharge of dredged material into ocean waters. Implementation Manual for Section 103 of PL-92-532. Environmental Effects Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. Second printing, April 1978.

APPENDIX A

LABORATORY PROCEDURES FOR PREPARING DREDGED MATERIAL AND CONDUCTING BIOASSAYS[1]

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure: Technician	Laboratory Director	Group Director
1. Store 3 samples of dredged sediment (DS) and 1 sample of reference sediment (RS) at 2-4° C in four separate containers. Mix sediment in each container as thoroughly as possible.	DS 3/29/79 1:00pm	TW (cr	TW (cr	[illegible]
	RS 4/2/79 3:00pm	"	"	"

Solid-phase Bioassays

Bioassays must be initiated by April 12, 1979 (2 weeks after March 29, 1979, date of dredged sediment collection). Maintain dissolved oxygen in aquaria at >4 ppm. Cover aquaria to prevent salinity changes.

Procedure	Date/Time of Implementation of Procedure	Technician	Laboratory Director	Group Director
2. Remove RS from storage and wet sieve through 1-mm mesh into single container (Use minimum volume of artificial sea water [ASW] of salinity of 30 ppt for seiving purposes.) Place nonliving material remaining on sieve in container.	4/9 9:00am	"	"	"
3. Mix RS in container and allow to settle for 6 hr.	4/9 9:30am	"	"	"
4. Decant ASW and mix RS as thoroughly as possible.	4/9 3:30pm	"	"	"
5. Assign treatments (3 DS samples), control (1 RS sample), and replicates (5 r per treatment and control) to aquaria.	4/9 10:30am	"	"	"
6. Randomly position aquaria (20) in environmental chamber maintained at 20±1°C.	4/9 10:30am	"	"	"

[1]This document is a copy of the work sheet that was used during the investigation. The document differs from the work sheet in that dates/times appear in typed form and certifications were added at a single time after the dates/times were typed.

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure: Technician	Laboratory Director	Group Director
7. Partially fill aquaria with ASW.	4/9 3:00pm	"	"	"
8. Place 30 mm of RS in each aquaria. Fill 1st aquarium to ∿10 mm, then 2nd aquarium to ∿10 mm, ..., and finally 20th aquarium to ∿10 mm. Repeat sequence until aquaria are filled to ∿20 mm. Repeat sequence again until aquaria are filled to ∿30 mm. This procedure will help to ensure that RS in all aquaria is homogeneous. Store remaining RS at 2-4°C for later use.	4/9 3:30-5:30pm	"	"	"
9. Replace ASW 1 hr after RS has been added to aquaria. Do not disturb sediment during replacement.	4/9 6:30-7:00pm	"	"	"
10. Select 400 hard clams from holding tanks and randomly distribute into 20 finger bowls. Follow same procedure for sandworms.	4/9 7:30pm	"	"	"
11. Randomly distribute contents of each set of 20 finger bowls into 20 aquaria.	4/9 8:00pm	"	"	"
12. If necessary, replace 75% of ASW 24 hr after animals are introduced into aquaria.	Not necessary	"	"	"
13. Acclimate animals for 48 hr. At end of this time period, remove dead animals and replace with live animals.	4/9 - 4/11	"	"	"

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure: Technician	Laboratory Director	Group Director
14. During acclimation period, remove appropriate volumes of 3 samples of DS from storage and wet-sieve each sample through 1-mm mesh into 3 separate containers. Use minimum volume of ASW for seiving purposes. Place nonliving material remaining on sieves in containers.	4/11	"	"	"
15. Mix material in containers and allow to settle for 6 hr.	4/11	"	"	"
16. Decant ASW and mix DS as thoroughly as possible.	4/11 2:30-5:00pm	"	"	"
17. Place 15 mm of appropriate sample of DS in each treatment aquarium. Employ basic strategy identified in Step 8.	4/11 4:30-6:30pm	"	"	"
18. Remove remaining RS from storage. Warm to test temperature (20±1°C). Add 15 mm to each reference aquarium. Employ basic strategy identified in Step 8.	4/11 12:00pm	"	"	"
19. Replace 75% of ASW 1 hr after addition of DS and final addition of RS.	4/11 7:30-8:30pm	"	"	"
20. Select 400 mysid shrimp from holding tank and randomly distribute into 20 finger bowls.	4/11 8:30pm	"	"	"
21. Randomly distribute contents of finger bowls into 20 aquaria.	4/11 9:00pm	"	"	"

Laboratory Procedures (Continued)

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Technician	Laboratory Director	Group Director
22. Perform the following activities:				
<u>Every day after introduction of mysid shrimp into aquaria</u>				
• Record salinity, temperature, dissolved oxygen and pH in each aquarium (record in log book)	Day 0 4/11 9:00pm			
	Day 1 4/12 6:00pm	"	"	"
	Day 2 4/13 4:00pm	"	"	"
	Day 3 4/14 2:00pm	"	"	"
• Record obvious mortality, formation of tubes or burrows, and unusual behavior patterns of animals (record in log book)	Day 4 4/15 1:00pm	"	"	"
	Day 5 4/16 2:00pm	"	"	"
	Day 6 4/17 3:00pm	"	"	"
	Day 7 4/18 2:00pm	"	"	"
	Day 8 4/19 3:00pm	"	"	"
	Day 9 4/20 3:00pm	"	"	"
	Day 10 4/21 10:00am	"	"	"
<u>Every 2 days after addition of DS and final addition of RS into aquaria</u>				
• Replace 75% of ASW	Day 2 4/13	"	"	"
	Day 4 4/15	"	"	"
	Day 6 4/17	"	"	"
	Day 8 4/19	"	"	"
23. At end of 10-day testing period, sieve sediment in each aquarium through 0.5-mm screen. Count live animals. Note sublethal responses.	4/21 10:00am-4:00pm	"	"	"

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure: Technician	Laboratory Director	Group Director
Suspended-Particulate-Phase Bioassays Bioassays must be initiated by April 12, 1979 (2 weeks after March 29, 1979, date of dredged-sediment collection). Maintain 14-hr light photoperiod with cool-white fluorescent bulbs mounted approximately 0.5-1 m above tops of aquaria. Maintain dissolved oxygen in aquaria at >4 ppm. Cover aquaria to prevent salinity changes.				
24. Prepare 3 suspended-particulate-phase samples. Follow procedures in Appendix B of EPA/COE Implementation Manual. In particular:				
• Clean laboratory glassware thoroughly	3/29	"	"	"
• Remove from storage appropriate volume of each sample of DS. Mix as thoroughly as possible. Combine with ASW in 1:4 ratio by volume. Shake on automatic shaker for 30 min at 100 oscillations/min. Do not allow dissolved oxygen to reach zero. Settle for 1 hr. Collect supernatant. Store initial volumes of suspended particulate phase at 2-4°C. Begin suspended-particulate-phase bioassays for each tested species (copepod, mysid shrimp, and silverside) as soon as sufficient suspended particulate phase is prepared. Combine all volumes prior to use in bioassays.	4/3 - 4/10	"	"	"
25. For each species tested assign treatments (10%, 50%, 100% suspended-particulate phase), control (100% ASW), and replicates (3 r per treatment and control) to aquaria/crystallizing dishes.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"

Laboratory Procedures (Continued)

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure: Technician	Laboratory Director	Group Director
26. For each species tested, randomly position aquaria/crystallizing dishes (30) in environmental chamber maintained at 20±1°C.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
27. Establish appropriate concentrations of suspended particulate phase and control water in aquaria/crystallizing dishes.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
28. Randomly distribute 10 individuals of each species into each aquarium/crystallizing dish. Cover aquaria/dishes.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
29. Monitor the following variables:				
<u>At start and end of 96-hr testing period</u>				
• Salinity, temperature, dissolved oxygen, and pH in each aquarium/crystallizing dish (record in log book) — Start of test	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
End of test	Copepod 4/14 Silverside 4/10,4/14 Mysid shrimp 4/14	"	"	"
<u>During 96-hr testing period</u>				
• Survival (record in log book) — Start of test (0 hr)	X	"	"	"
4 hr	X	"	"	"
8 hr	X	"	"	"
24 hr	X	"	"	"
48 hr	X	"	"	"
72 hr	X	"	"	"
End of test (96 hr)	X	"	"	"

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure: Technician	Laboratory Director	Group Director
Liquid-Phase Bioassays				
Bioassays must be initiated by April 12, 1979 (2 weeks after March 29, 1979, date of dredged-sediment collection). Maintain 14-hr light photoperiod with cool-white fluorescent bulbs mounted approximately 0.5-1 m above tops of aquaria. Maintain dissolved oxygen in aquaria at >4 ppm. Cover aquaria to prevent salinity changes.				
30. Prepare 3 liquid-phase samples. Follow procedures in Appendix B of EPA/COE Implementation Manual. In particular:				
• Clean laboratory glassware, filtration equipment, and filters (0.45 μ)	4/2	"	"	"
• Remove from storage appropriate volume of each sample of DS. Mix as thoroughly as possible. Combine with ASW in 1:4 ratio by volume. Shake on automatic shaker for 30 min at 100 oscillations/min. Do not allow dissolved oxygen to reach zero. Settle for 1 hr. Collect supernatant and filter (centrifugation may be employed if needed to expedite filtration process). Discard first 50 ml of filtrate passed through each filter. Collect remainder of filtrate. Store initial volumes of liquid phase at 2-4°C. Begin liquid phase bioassays for each tested species (copepod, mysid shrimp, and silverside) as soon as sufficient liquid phase is prepared. Combine all volumes prior to use in bioassays.	4/3 - 4/10	"	"	"
31. For each species tested, assign treatments (10%, 50%, 100% liquid phase), control (100% ASW), and replicates (3 r per treatment and control) to aquaria/crystallizing dishes.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Technician	Laboratory Director	Group Director
32. For each species tested, randomly position aquaria/crystallizing dishes (30) in environmental chamber maintained at 20±1°C.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
33. Establish appropriate concentrations of liquid phase and control water in aquari/crystallizing dishes.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
34. Randomly distribute 10 individuals of each species into each aquarium/crystallizing dish. Cover aquaria/dishes.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
35. Monitor the following variables:				
<u>At start and end of 96-hr testing period</u>				
• Salinity, temperature, dissolved oxygen, and pH in each aquarium/crystallizing dish (record in log book). Start of test	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
End of test	Copepod 4/14 Silverside 4/10,4/14 Mysid shrimp 4/14	"	"	"
<u>During 96-hr testing period</u>				
• Survival (record in log book) Start of test (0 hr)	X	"	"	"
4 hr	X	"	"	"
8 hr	X	"	"	"
24 hr	X	"	"	"
48 hr	X	"	"	"
72 hr	X	"	"	"
End of test (96 hr)	X	"	"	"

B.1 Liquid Phase Bioassays

Table B1. Results of liquid phase bioassays with the copepod, *Acartia tonsa*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors 0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control	1	10	10	10	10	9	9	9
	2	10	10	10	9	8	8	8
	3	10	10	10	10	10	10	10
Mean ($\bar{x}$):								9.00 (90.0%)
10% liquid phase								
Dredged material - Sample A	1	10	10	10	10	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	9	8
Dredged material - Sample B	1	10	10	10	10	10	10	9
	2	10	10	10	9	9	9	9
	3	10	10	10	9	9	8	8
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	8	8	7
	3	10	10	10	10	10	10	9
50% liquid phase								
Dredged material - Sample A	1	10	10	10	9	9	9	8
	2	10	10	10	10	10	10	10
	3	10	10	9	9	8	8	8
Dredged material - Sample B	1	10	10	10	10	9	9	9
	2	10	10	10	9	8	8	7
	3	10	10	10	9	9	9	9
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	9	9	9	9
	3	10	10	10	10	9	8	8

Table B1. (Continued)

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors 0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr	
<u>100% liquid phase</u>									
Dredged material - Sample A	1	10	10	10	10	5	5	4	
	2	10	10	9	9	8	8	8	
	3	10	10	10	8	6	6	4	
	Mean ($\bar{x}$):							5.33	(53.3%)
Dredged material - Sample B	1	10	10	10	9	7	7	5	
	2	10	10	10	8	6	5	5	
	3	10	10	9	9	9	8	8	
	Mean ($\bar{x}$):							6.00	(60.0%)
Dredged material - Sample C	1	10	10	9	5	3	3	3	
	2	10	10	10	10	10	9	9	
	3	10	10	10	9	7	6	6	
	Mean ($\bar{x}$):							6.00	(60.0%)

[a]Bioassays were conducted at 20$\pm$1°C in 200-ml crystallizing dishes. A 14-hr light ($\sim$1200 μw/cm^2 at surface of dishes) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.0-6.7 ml/l at the start of the bioassays to 5.9-6.6 ml/l at the end of the tests. pH varied from 7.6-7.9 (start of bioassays) to 7.4-7.9 (end of bioassays). Salinity was maintained at 30-31 ppt.

Table B2. Results of liquid phase bioassays with the mysid shrimp, *Mysidopsis bahia*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	9
	Mean ($\bar{x}$):							9.67 (96.7%)
10% liquid phase								
Dredged material - Sample A	1	10	10	10	9	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample B	1	10	10	10	10	10	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample C	1	10	10	9	9	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	9	9
50% liquid phase								
Dredged material - Sample A	1	10	10	10	10	10	10	9
	2	10	10	10	10	10	10	10
	3	10	10	10	9	9	9	9
Dredged material - Sample B	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10

Table B2. (Continued)

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
<u>100% liquid phase</u>								
Dredged material - Sample A	1	10	10	10	10	10	10	10
	2	10	10	10	10	9	9	9
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							9.67 (96.7%)
Dredged material - Sample B	1	10	10	10	10	10	9	9
	2	10	10	10	9	9	9	9
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							9.33 (93.3%)
Dredged material - Sample C	1	10	10	10	10	9	8	5
	2	10	10	10	9	9	8	8
	3	10	10	10	10	8	6	6
	Mean ($\bar{x}$):							6.33 (63.3%)

[a]Bioassays were conducted at 20±1°C in 200-ml crystallizing dishes. Animals were fed live 48-hr-old *Artemia* (brine shrimp) nauplii at a rate of ~1 ml of culture/dish/day. A 14-hr light (~1200 μw/cm^2 at surface of dishes) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.2-6.9 ml/l at the start of the bioassays to 6.0-6.6 ml/l at the end of the tests. pH varied from 7.7-7.9 (start of bioassays) to 7.4-7.8 (end of bioassays). Salinity was maintained at 30-31 ppt.

Table B3. Results of liquid phase bioassays with the Atlantic silverside, *Menidia menidia*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors 0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							10.0 (100.0%)
10% liquid phase								
Dredged material - Sample A	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample B	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
50% liquid phase								
Dredged material - Sample A	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample B	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	9	9	9
	3	10	10	10	10	10	10	10

Table B3. (Continued)

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors 0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr	
100% liquid phase									
Dredged material - Sample A	1	10	10	10	10	10	10	10	
	2	10	10	10	10	10	10	10	
	3	10	10	10	10	10	10	10	
	Mean ($\bar{x}$):							10.0	(100.0%)
Dredged material - Sample B	1	10	10	10	10	10	10	10	
	2	10	10	10	10	10	10	10	
	3	10	10	10	10	10	10	10	
	Mean ($\bar{x}$):							10.0	(100.0%)
Dredged material - Sample C	1	10	10	10	10	10	10	10	
	2	10	10	10	10	10	10	10	
	3	10	10	10	10	10	10	10	
	Mean ($\bar{x}$):							10.0	(100.0%)

[a]Bioassays were conducted at 20$\pm$1°C in 19-l aquaria. A 14-hr light (~1200 μw/cm^2 at surface of aquaria) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.0-6.9 ml/l at the start of the bioassays to 5.0-6.0 ml/l at the end of the tests. pH varied from 7.6-8.0 (start of bioassays) to 7.4-7.9 (end of bioassays). Salinity was maintained at 30-31 ppt.

B.2 Suspended Particulate Phase Bioassays

Table B4. Results of suspended particulate phase bioassays with the copepod, *Arcartia tonsa*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control	1	10	10	10	10	10	10	10
	2	10	10	9	9	9	8	8
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							9.33 (93.3%)
10% suspended particulate phase								
Dredged material - Sample A	1	10	10	9	9	8	8	8
	2	10	10	10	10	10	10	10
	3	10	10	9	9	8	7	7
Dredged material - Sample B	1	10	10	10	10	10	9	9
	2	10	10	10	10	10	10	9
	3	10	10	10	9	8	8	7
Dredged material - Sample C	1	10	10	10	9	9	8	8
	2	10	10	10	10	9	9	9
	3	10	10	10	10	10	10	10
50% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	10	10	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	9	9	9	9
Dredged material - Sample B	1	10	10	10	10	9	8	8
	2	10	10	10	10	10	9	9
	3	10	10	10	8	8	8	8
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	9	9	9	8	8
	3	10	10	10	10	9	9	9

Table B4. (Continued)

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors 0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr	
<u>100% suspended particulate phase</u>									
Dredged material - Sample A	1	10	10	10	9	7	5	5	
	2	10	10	9	8	8	8	7	
	3	10	10	10	10	8	6	4	
	Mean ($\bar{x}$):							5.33	(53.3%)
Dredged material - Sample B	1	10	10	10	10	9	8	5	
	2	10	10	10	9	6	4	4	
	3	10	10	10	10	9	8	8	
	Mean ($\bar{x}$):							5.67	(56.7%)
Dredged material - Sample C	1	10	10	9	8	5	3	3	
	2	10	10	10	10	9	5	5	
	3	10	10	9	7	7	7	7	
	Mean ($\bar{x}$):							5.00	(50.0%)

[a]Bioassays were conducted at 20 ± 1°C in 200-ml crystallizing dishes. A 14-hr light ($\sim$1200 μw/cm^2 at surface of dishes) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.1-6.9 ml/l at the start of the bioassays to 5.8-6.6 ml/l at the end of the tests. pH varied from 7.7-7.9 (start of bioassays) to 7.4-7.9 (end of bioassays). Salinity was maintained at 30-31 ppt.

Table B5. Results of suspended particulate phase bioassays with the mysid shrimp, *Mysidopsis bahia*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors 0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control	1	10	10	10	10	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	9
Mean ($\bar{x}$):								9.33 (93.3%)
10% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	10	10	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample B	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
50% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	9	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample B	1	10	10	10	10	10	9	7
	2	10	10	10	10	10	10	10
	3	10	10	10	10	9	9	9
Dredged material - Sample C	1	10	10	10	10	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	9

Table B5. (Continued)

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
100% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	10	9	7	7
	2	10	10	10	8	6	6	5
	3	10	10	10	10	10	9	8
	Mean ($\bar{x}$):							6.67 (66.7%)
Dredged material - Sample B	1	10	10	10	10	10	9	9
	2	10	10	10	9	9	9	8
	3	10	10	10	10	8	6	6
	Mean ($\bar{x}$):							7.67 (76.7%)
Dredged material - Sample C	1	10	10	10	9	9	8	8
	2	10	10	10	6	4	4	2
	3	10	10	10	8	5	5	5
	Mean ($\bar{x}$):							5.00 (50.0%)

[a]Bioassays were conducted at 20±1°C in 200-ml crystallizing dishes. Animals were fed live 48-hr-old *Artemia* (brine shrimp) nauplii at a rate of ~1 ml of culture/dish/day. A 14-hr light (~1200 μm/cm^2 at surface of dishes) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.5-6.9 ml/l at the start of the bioassays to 6.0-6.8 ml/l at the end of the tests. pH varied from 7.7-7.9 (start of bioassays) to 7.4-7.9 (end of bioassays). Salinity was maintained at 30-31 ppt.

Table B6. Results of suspended particulate phase bioassays with the Atlantic silverside, *Menidia menidia*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Mean ($\bar{x}$):								10.0 (100.0%)
10% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample B	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
50% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample B	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10

Table B6. (Continued)

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors 0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr	
100% suspended particulate phase									
Dredged material - Sample A	1	10	10	10	10	10	10	10	
	2	10	10	10	10	10	10	10	
	3	10	10	10	10	10	10	10	
	Mean ($\bar{x}$):							10.0	(100.0%)
Dredged material - Sample B	1	10	10	10	10	10	10	10	
	2	10	10	10	10	10	10	10	
	3	10	10	10	10	10	10	10	
	Mean ($\bar{x}$):							10.0	(100.0%)
Dredged material - Sample C	1	10	10	10	10	10	10	10	
	2	10	10	10	10	10	10	10	
	3	10	10	10	10	10	10	10	
	Mean ($\bar{x}$):							10.0	(100.0%)

[a]Bioassays were conducted at 20$\pm$1°C in 19-l aquaria. A 14-hr light ($\sim$1200 µw/cm^2 at surface of aquaria) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.0-7.1 ml/l at the start of the bioassays to 5.0-5.9 ml/l at the end of the tests. pH varied from 7.7-8.0 (start of bioassays) to 7.3-7.9 (end of bioassays). Salinity was maintained at 30-32 ppt.

B.3 Solid Phase Bioassays

Table B7. Results of solid phase bioassays with the mysid shrimp (Neomysis americana), hard clam (Mercenaria mercenaria), and sandworm (Nereis virens)[a]

Treatment (t):	Number of Survivors[b,c]															
	Control (Reference) Sediment				Dredged Material - Sample A				Dredged Material - Sample B				Dredged Material - Sample C			
Replicate (r)	Mysid Shrimp[d]	Hard Clam	Sandworm	Total	Mysid Shrimp[d]	Hard Clam	Sandworm	Total	Mysid Shrimp[d]	Hard Clam	Sandworm	Total	Mysid Shrimp[d]	Hard Clam	Sandworm	Total
1	18	17	19	54	5	19	20	44	8	18	20	46	1	20	19	40
2	20	18	18	56	7	16	19	42	4	16	18	38	0	19	19	38
3	16	19	20	55	2	20	19	41	3	18	19	40	5	20	20	45
4	19	20	18	57	7	20	18	45	6	20	17	43	2	17	19	38
5	18	19	19	56	6	19	19	44	0	19	19	38	4	18	19	41
Mean ($\bar{x}$)	18.2	18.6	18.8	55.6	5.4	18.8	19.0	43.2	4.2	18.2	18.6	41.0	2.4	18.8	19.2	40.4
_______(%)	(91.0)	(93.0)	(94.0)	(92.7)	(27.0)	(94.0)	(95.0)	(72.0)	(21.0)	(91.0)	(93.0)	(68.3)	(12.0)	(94.0)	(96.0)	(67.3)

[a]Bioassays were conducted at 20±1° C in 38-l aquaria. Animals were exposed to each replication of a treatment in a single aquarium. Water in aquaria was exchanged by the replacement, as compared to the flow-through method. Mysid shrimp were fed live 48-hr-old Artemia (brine shrimp) nauplii at a rate of approximately 10 ml of culture/aquarium/day. A 14-hour light and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Water in aquaria was aerated. Minmum recorded values of dissolved oxygen and pH during the bioassays were 5.7 ml/l and 7.3, respectively. Salinity was maintained at 30 ppt.

[b]Twenty (20) individuals of each species were initially exposed to each replication of a treatment. Thus, a total of 60 animals were employed in each aquarium.

[c]In addition to monitoring survival of all species, burrowing behavior of sandworms was noted at 2-day intervals. No differences were observed among aquaria.

[d]Mortality of mysid shrimp was qualitatively monitored during the bioassays by noting dead individuals on the surface of the sediment. Most mortality occurred during the first 5 days of the bioassays. Mortality of shrimp exposed to dredged material appeared to be at least partly associated with fouling of animals by fine particulate matter.

SECTION C

CULTURAL RESOURCES

The Chelsea Naval Hospital constitutes a significant cultural resource, as designated by its inclusion on the National Register of Historic Places. Exhibits 5-1 to 5-4 are copies of the nomination papers to the National Register and contain detailed background information on the historical importance of the Naval Hospital area.

Form 10-300 (Rev. 6-72)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY - NOMINATION FORM

(Type all entries complete applicable sections)

STATE: Massachusetts
COUNTY: Suffolk
FOR NPS USE ONLY
ENTRY DATE

1. NAME

COMMON: Naval Hospital Boston

AND/OR HISTORIC: Naval Hospital

2. LOCATION

STREET AND NUMBER: 1 Broadway

CITY OR TOWN: Chelsea

CONGRESSIONAL DISTRICT: 1st Suffolk, 7th Congressional

STATE: Massachusetts CODE: 25

COUNTY: Suffolk CODE: 025

3. CLASSIFICATION

CATEGORY (Check One)	OWNERSHIP		STATUS	ACCESSIBLE TO THE PUBLIC
[X] District [ ] Building	[X] Public	Public Acquisition:	[X] Occupied	Yes:
[ ] Site [ ] Structure	[ ] Private	[ ] In Process	[ ] Unoccupied	[ ] Restricted
[ ] Object	[ ] Both	[ ] Being Considered	[ ] Preservation work in progress	[X] Unrestricted
				[ ] No

PRESENT USE (Check One or More as Appropriate)

[ ] Agricultural	[ ] Government	[ ] Park	[ ] Transportation	[ ] Comments
[ ] Commercial	[ ] Industrial	[ ] Private Residence	[ ] Other (Specify)	
[ ] Educational	[X] Military	[ ] Religious		
[ ] Entertainment	[ ] Museum	[X] Scientific (Medical)		

4. OWNER OF PROPERTY

OWNER'S NAME: Department of the Navy

STREET AND NUMBER:

CITY OR TOWN: Washington

STATE: District of Columbia CODE:

STATE: Massachusetts

5. LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC: Suffolk County Court House

STREET AND NUMBER: Pemberton Square

CITY OR TOWN: Boston

STATE: Massachusetts CODE: 025

COUNTY: Suffolk

6. REPRESENTATION IN EXISTING SURVEYS

TITLE OF SURVEY: General Development Map

DATE OF SURVEY: 4/3/69 [X] Federal [ ] State [ ] County [ ] Local

DEPOSITORY FOR SURVEY RECORDS: Naval Facilities Engineering Command

STREET AND NUMBER: Philadelphia Naval Base

CITY OR TOWN: Philadelphia

STATE: Pennsylvania CODE:

FOR NPS USE ONLY
ENTRY NUMBER
DATE

SEE INSTRUCTIONS

7. DESCRIPTION (cont.)

the roof. The roof is pyramidal with 5 dormers in front, apparently added after 1836, the center one being three narrow windows wide; the others being standard width windows. There is a skylight on the Eastern roof, reputed to be over the old surgical ward. There are ventilation flues on western end of main building, 2 closely spaced dormer windows on west end. The 1903 attachment to the north has a pitched roof with no dormer.

Facade: gable end on West
relatively flat facade with center double-window bay on three floors as shallow octagonal inset.
Windows: on Western half of main building, 2 bays across
Northern addition has pitched roof, interior chimney, 3 narrow bays wide, 4 bays deep
Coursing: granite
Fronts on river and is on southern exposure of the hill. Built to accommodate 100 patients.
Since 1915 has housed personnel assigned to the hospital; now serves officially as Bachelor Officer Quarters.
See Attached Picture

Buildings 2 and 3 of Naval Hospital Boston date back to about 1836; in 1835 a Naval Appropriation Act had transferred to the Bureau of Ordnance an area of land for a Magazine Site. Building 2 of huge granite, rough ashlars, was divided by two longitudinal brick walls and the original roof, still intact, is of brick, in long arches toward the center, except the central area which is of brick, but of the "dome" type, numerous small domes of about 1 foot in diameter. A slate roof of the 2-way slope supported by structural steel has evidently been added in comparatively recent times and the building is now so designed that explosion will be directed upward through the roof, rather than outward through the walls.

Building 3 was of same construction and was used during the period the Radio Station was used at this site; it was converted and used as quarters for Chief Radio Operator.

These were transferred back to the Naval Hospital in February 1931 and are now used as storerooms.

Building 59 of Naval Hospital Boston, now in use as Bachelor Enlisted Quarters and undergoing interior modernization, was completed in December 1857 as a Marine Hospital, for which Congress sold 10 acres of the Naval Hospital site to the Treasury Department for $50,000. The brick building cost was $393,452.48. There were originally three stories above a basement, but after 1866, a fourth story was added by the adoption of a "French" or mansard roof, allowing the use of the attic. In 1939, a severe hurricane tore the slate roof off and uprooted 69 trees. The dormers have subsequently been altered to shed-type.

The original design provided for a central building 80' long, 50' wide with wings on each end 100' long and 30' wide. On both the facade and the rear

(cont.)

Naval Hospital Boston

7. DESCRIPTION (cont.)

elevation the first, second and third floors with 8 rounded arches in each had arcades extending between the two protruding wings. The facade arches are now glassed in. There appears to be a single exterior chimney extending through the roof on the left wing. Although much of the original iron work is still in evidence, around the entries, it was discovered at an early date that flaws in the windows and cast iron roof permitted seepage and a new roof was proposed. The storeroom and laundry to the rear are brick; the stable, isolation ward and gate house were frame. Subsequently, the stable and storeoom have been converted to other uses. The building even as it now stands reflects the 19th Century's experimentation with iron columns; and the arcades and curved dormer windows of the mansard roof reflected the French influence of that period.

In June 1940, the building was released to the Navy Department once more. There are a number of other buildings in the Naval Hospital Boston Historic District over 50 years of age but it is believed that the five discussed above are of primary historical importance. As a matter of general interest, however, some of the other buildings and their dates are:

The Red Cross Building	1918
The Enlisted Men's Club	1920
The Maintenance Garage	1900
The Paint Shop	1918
The Waves Quarters	1900
Quarters B & C	1907
Quarters O & P	1900
Quarters T & U	1900
Quarters H	1910
Quarters D & E	1927

8. SIGNIFICANCE

PERIOD *(Check One or More as Appropriate)*

- [ ] Pre-Columbian
- [ ] 15th Century
- [ ] 16th Century
- [ ] 17th Century
- [ ] 18th Century
- [X] 19th Century
- [X] 20th Century

SPECIFIC DATE(S) *(If Applicable and Known)*

AREAS OF SIGNIFICANCE *(Check One or More as Appropriate)*

- Aboriginal
  - [ ] Prehistoric
  - [ ] Historic
- [ ] Agriculture
- [ ] Architecture
- [ ] Art
- [ ] Commerce
- [ ] Communications
- [ ] Conservation
- [ ] Education
- [ ] Engineering
- [ ] Industry
- [ ] Invention
- [ ] Landscape Architecture
- [ ] Literature
- [X] Military
- [ ] Music
- [ ] Political
- [ ] Religion/Philosophy
- [ ] Science
- [ ] Sculpture
- [ ] Social/Humanitarian
- [ ] Theater
- [ ] Transportation
- [ ] Urban Planning
- [ ] Other *(Specify)* Medical

STATEMENT OF SIGNIFICANCE

Naval Hospital Boston is the oldest Naval Hospital in continuous active service in the United States. Historically, apparently referred to as "Naval Hospital at Charlestown (Chelsea site)," then as Naval Hospital, Chelsea, and currently as Naval Hospital Boston, Chelsea. The current designation was effected in order to indicate the proximity of the Naval Hospital facilities and training programs to the acknowledged outstanding medical environment of Boston and thus attract potential Navy doctors to the Chelsea duty station.

Currently, Naval Hospital Boston comprises numerous buildings. Building 1 is known to have been commissioned and opened January 7, 1836, one of the first three hospitals authorized specifically to accommodate Naval personnel, who until that time had been treated at Marine hospitals, supported in large part by personal taxes levied on Naval personnel (twenty cents a month from pay of every officer, seaman and marine in the naval service). Naval personnel were dissatisfied with what they considered meager facilities of the Marine Hospital and often deserted rather than use the facilities.

The acreage of the district is directly traceable to Samuel Maverick and was the site of the first permanent settlement in the Massachusetts Bay Colony in Boston Harbor; i.e., Samuel Maverick's Palisades House, which records show he fortified in 1625 against the Indian attacks. The hospital site was the terminus of the first county road in the Colony - the Salem Turnpike, now Broadway in Chelsea; also, it was the site of the landing of the first ferry between Winnisimmet (now Chelsea), Charlestown and Boston, May 8, 1631. The toll gate was at the entrance to the hospital grounds and records indicate some disagreement as to the right of way. It is believed that the site was occupied in 1775 by the left wing of Washington's army; likewise, the people of Chelsea are reputed to have gathered on the site to watch the Battle of Bunker Hill in progress across the Mystic River on June 17, 1775; many of the wounded were brought back to the hillside by boat.

In 1811, Congress authorized withdrawal of the Naval Portion of the tax monies collected from sea-going personnel ($50,000) and transferred it to a Naval Hospital Fund. The Secretary of War, the Secretary of the Navy and the Secretary of the Treasury were directed to administer the fund as a Board of Commissioners. On July 10, 1832, Congress made the Secretary of the Navy the sole trustee and also provided for the construction of Naval Hospitals at Charlestown, Mass. (Chelsea site), Brooklyn, N.Y., and Pensacola, Florida.

On September 23, 1823, Dr. Aaron Dexter, a Boston physician, sold approximately 115 acres for $18,000 to the Commissioners of Naval Hospitals; because of uncertainty as to the legality of the transaction, on 4

(cont.)

SEE INSTRUCTIONS

Naval Hospital Boston

8. SIGNIFICANCE (cont.)

December 1826, Dr. Dexter again deeded the same site to "The United States of America." The Massachusetts Legislature ceded to the United States jurisdiction over the site on 20 February 1828, reserving the right to serve its civil and criminal processes.

In 1832, $26,000 was appropriated out of U. S. Treasury for construction at Charlestown, Mass. (Chelsea site) because in the War of 1812 money of the Naval Hospital Fund had been used for other purposes; and the Treasury appropriation was a form of retribution with no exact accounting. Other sums were appropriated in 1835 and 1836 and 1837, at which time $2750 was included for the Magazine.

The physical features of Dr. Dexter's land were of great value in establishing the hospital there. It was high (112' above sea level) and accessible to good water transportation, being right on the Mystic River and one terminus of a ferry, and to good land transportation, being at the end of the Salem Turnpike. The site was ideal and in selection of the appropriate site for the Marine Hospital to be built, the Collector and Hospital Agent of the Marine Hospital wrote to the Secretary of Treasury in December 1854, "As regards accessibility, airiness, salubrity, and isolation, they (the grounds owned by Naval Hospital in Chelsea) are all that could be wished." Westerly breezes from the river and the hospital is protected by the hill from the NE storms which prevail for six months of the year. Water is supplied from the Mystic reservoir and is abundant in quantity and very good in quality. The atmosphere was thus considered clean and healthy, and the institution later proved to be the only naval hospital on the entire Atlantic coast absolutely free from malarial poison.

In 1836 ground was turned over to the Bureau of Ordnance for a Magazine. The Buildings 2 and 3 were built as magazines and also subsequently used in connection with a radio station established on the hospital site and subsequently discontinued and now used as storerooms. It is believed that the Constitution was loaded with ammunition directly from these magazines. The Bureau of Ordnance returned the property to hospital cognizance in 1911.

In the middle of the 19th Century, 10 acres were sold to the Treasury Department as the site of a new Marine Hospital Building (the forerunner of the Public Health Hospital) which was completed in December 1857. The building has had some alterations through the years, e.g., a fourth story added in 1866 and a new roof after the 1938 hurricane, but the basic design is reasonably intact. The building, which in time of need also served the overload from the Navy Hospital, was returned officially to the Navy Department and has since been used as Bachelor Enlisted Quarters.

Many other buildings (both temporary and permanent in structure) have been erected on the site; the current main hospital building - Building #22 - was completed in 1915, just in time to struggle with the very severe flu epidemic of 1917.

9. MAJOR BIBLIOGRAPHICAL REFERENCES

For the Relief of the Sick and Disabled, A History of the First U. S. Public Health Service Hospital, Richard H. Thurm, 1970

Official records, correspondence and documents on file at Naval Hospital Boston.

10. GEOGRAPHICAL DATA

LATITUDE AND LONGITUDE COORDINATES DEFINING A RECTANGLE LOCATING THE PROPERTY

CORNER	LATITUDE Degrees	Minutes	Seconds	LONGITUDE Degrees	Minutes	Seconds
NW	42°	23'	38"	71°	02'	58"
NE	42°	23'	25½"	71°	02'	31"
SE	42°	23'	04½"	71°	02'	48"
SW	42°	23'	17"	71°	03'	16"

OR

LATITUDE AND LONGITUDE COORDINATES DEFINING THE CENTER POINT OF A PROPERTY OF LESS THAN TEN ACRES

LATITUDE Degrees	Minutes	Seconds	LONGITUDE Degrees	Minutes	Seconds
°	'	"	°	'	"

APPROXIMATE ACREAGE OF NOMINATED PROPERTY: 87.85 acres

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE:	CODE	COUNTY	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE

11. FORM PREPARED BY

NAME AND TITLE:
Captain James M. Sanders, Jr., MSC, USN, Administrative Officer

ORGANIZATION: Naval Hospital Boston

DATE: March 1, 1973

STREET AND NUMBER: 1 Broadway

CITY OR TOWN: Chelsea, Massachusetts

STATE: Massachusetts

CODE:

12. STATE LIAISON OFFICER CERTIFICATION

As the designated State Liaison Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service. The recommended level of significance of this nomination is:

National ☒ State ☐ Local ☐

Name

JOHN F.X. DAVOREN, Secretary of the Commonwealth; Chairman of the

Title Mass. Historical Commission

Date

NATIONAL REGISTER VERIFICATION

I hereby certify that this property is included in the National Register.

Director, Office of Archeology and Historic Preservation

Date

ATTEST:

Keeper of The National Register

Date

SEE INSTRUCTIONS

APPENDIX 6

ECONOMIC APPENDIX

APPENDIX 6

ECONOMIC ANALYSIS

SECTION A
ANALYSIS OF PROJECT COSTS AND BENEFITS

1. This appendix contains the detailed analyses of the benefits and costs of the alternative plans. Benefits and costs are calculated and compared for each alternative to determine each plan's economic feasibility. Section B of this appendix contains a detailed economic analysis of the proposed channel depth and width.

METHODOLOGY

2. Benefits attributable to the federal project are derived from increased use of the Island End River for recreational boating. At the present time, recreational use of the Island End River is nonexistent. By dredging a channel to the site of the proposed marina, the federal project would permit the City of Chelsea to feasibly develop the marina in accordance with its development plans for the Chelsea Naval Hosptial site. This would also expand the supply of safe and convenient mooring spaces. Given the present backlog of applications for mooring spaces in the Boston area, and the expected continued growth of recreational boating, the benefits resulting from this project are expected to be net benefits to the national economy. That is, the opportunities for recreational boating will be new opportunities that would not be available otherwise, and are not due merely to the transference of boating benefits from other areas.

3. Benefits are calculated in economic terms by estimating the annual return to boat owners as if the boats were "for hire." This is a measure of the boat owners "willingness to pay" for recreational benefits. The ideal percentage of return is considered the maximum return that could be expected with full unrestricted use of the harbor. At the present time, the actual return is 0% of the ideal. With the proposed improvements, actual return would range up to 95% of the ideal return depending upon the type of boat.

PROJECTIONS OF THE RECREATIONAL BOAT FLEET

4. Projections of recreational boat use in the Island End River were required to establish the economic benefits of the project as well as to determine the required mooring area and channel dimensions.

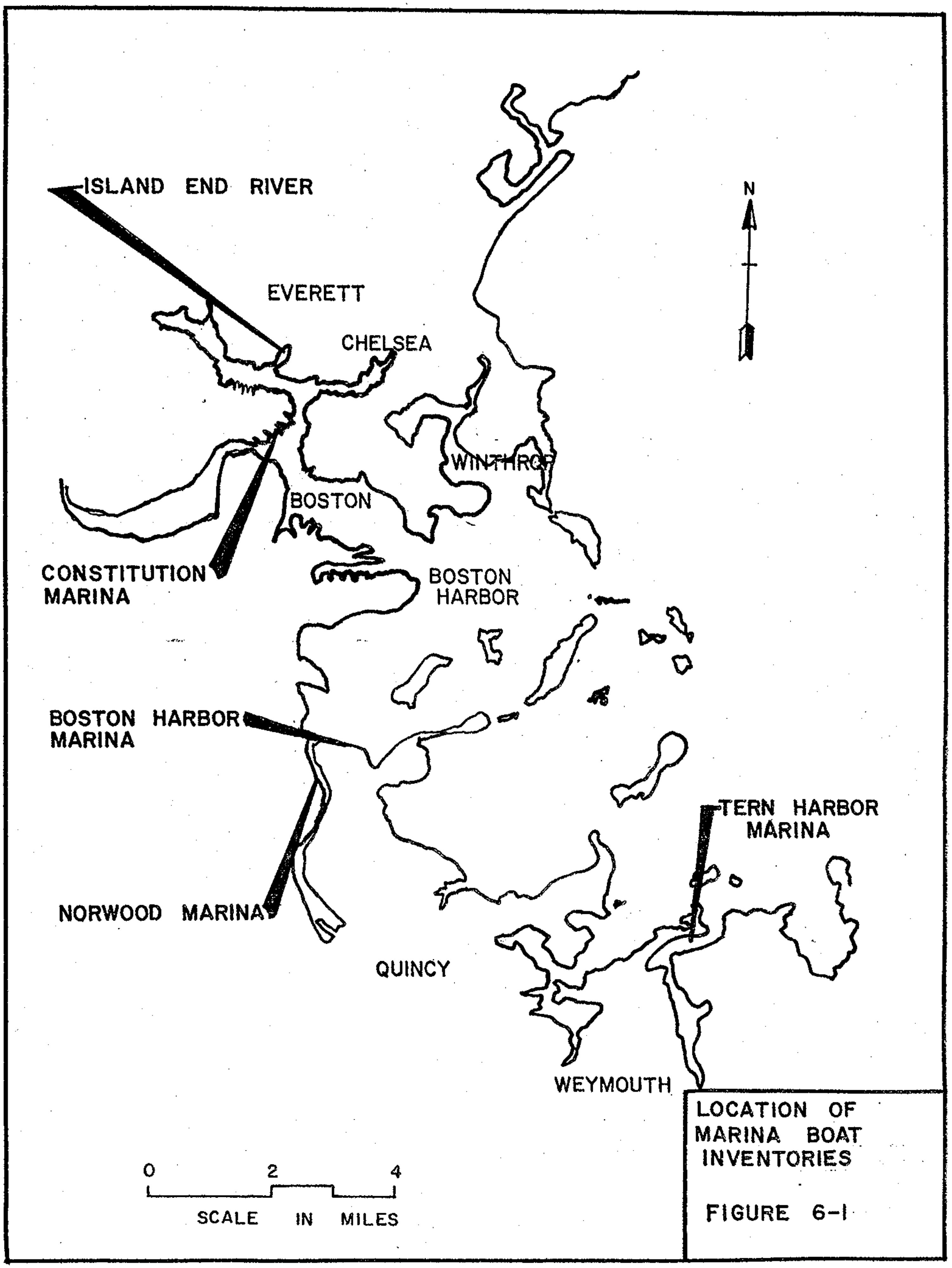
5. Because there is currently no recreational boating in the Island End River projections of future use were made based on the types of boats observed at four nearby marinas. Four marinas in the greater Boston area

that were considered to be representative of the Island End River site were examined. The locations of the marinas are shown in Figure 6-1. The marinas selected were fairly large and privately owned and operated. The Boston Harbor Marina, Norwood Marina and then Tern Harbor Marina were considered representative due to their locations on rivers with fairly shallow depths, and the availability of shore facilities similar to those proposed for the Island End River Marina. The Constitution Marina was selected due to its comparable size and its nearby location.

6. Inventories were taken by visually classifying moored boats by size and type. The observations were made on a weekday morning during the summer.

The results of the surveys are shown in Tables 6-1 through 6-5. Table 6-5 shows the average mix of boats for the four marinas surveyed.

7. Table 6-6 shows the mix of boats projected for the Island End River. The percentages shown in this table reflect a slightly higher percentage of sailboats than observed at the four marinas. The number of sailboats is anticipated to be higher in the future due to increases in the price of fuel. Within the categories of power boats and sailboats, the breakdown by percent is the same as observed in the survey.



LOCATION OF MARINA BOAT INVENTORIES

FIGURE 6-1

TABLE 6-1

RECREATIONAL FLEET OBSERVED AT NORWOOD MARINA, BOSTON

Type of Craft	Length	Number	Percent
Outboards	15-20	9	10.4
	20+	1	1.2
Sterndrive	15-20	5	5.8
	21-25	10	11.6
	26+	5	5.8
Inboards	15-20	2	2.3
	21-30	27	31.4
	31-40	13	15.1
	41-50	2	2.3
	51+	1	1.2
Cruising Sailboats	15-20	0	0
	21-30	6	7.0
	31-40	3	3.5
	41+	0	0
Daysailers	8-15	1	1.2
	16-20	5	5.0
	21-25	1	1.2
	26+	0	0
		86	100.0

TABLE 6-2
RECREATIONAL FLEET OBSERVED AT TERN HARBOR MARINA, WEYMOUTH

Type of Craft	Length	Number	Percent
Outboards	15-20	14	12.3
	20+	2	1.8
Sterndrive	15-20	2	1.8
	21-25	4	3.5
	26+	1	0.9
Inboards	15-20	1	0.9
	21-30	35	30.7
	31-40	15	13.1
	41-50	6	5.2
	51+	2	1.8
Cruising Sailboats	15-20	1	0.9
	21-30	16	14.0
	31-40	11	9.6
	41+	0	0
Daysailers	8-15	1	0.9
	16-20	1	0.9
	21-25	2	1.8
	26+	0	0
		114	100.0

TABLE 6-3
RECREATIONAL FLEET OBSERVED AT BOSTON HARBOR

Type of Craft	Length	Number	Percent
Outboards	15-20	37	10.9
	20+	7	2.1
Sterndrive	15-20	6	1.8
	21-25	35	10.3
	26+	9	2.7
Inboards	15-20	3	0.9
	21-30	107	31.6
	31-40	50	14.8
	41-50	3	0.9
	51+	1	0.3
Cruising Sailboats	15-20	0	0
	21-30	56	16.6
	31-40	15	4.4
	41+	0	0
Daysailers	8-15	1	0.3
	16-20	2	0.6
	21-25	5	1.5
	26+	1	0.3
		338	100.0

TABLE 6-4
RECREATIONAL FLEET OBSERVED AT CONSTITUTION MARINA, BOSTON

Type of Craft	Length	Number	Percent
Outboards	15-20	6	3.6
	20+	2	1.2
Sterndrive	15-20	4	2.4
	21-25	13	7.8
	26+	7	4.2
Inboards	15-20	3	1.8
	21-30	22	13.2
	31-40	22	13.2
	41-50	9	5.4
	51+	0	0
Cruising Sailboats	15-20	1	0.6
	21-30	43	25.7
	31-40	23	13.7
	41+	3	1.8
Daysailers	8-15	0	0
	16-20	7	4.2
	21-25	2	1.2
	26+	0	0
		167	100.0

TABLE 6-5
RECREATIONAL FLEET OBSERVED AT FOUR MARINAS

Type of Craft	Length	Number	Percent
Outboards	15-20	66	9.4
	20+	12	1.7
Sterndrive	15-20	17	2.4
	21-25	62	8.8
	26+	22	3.1
Inboards	15-20	9	1.3
	21-30	191	27.0
	31-40	100	14.2
	41-50	20	2.8
	51+	4	0.6
Cruising Sailboats	15-20	2	0.3
	21-30	121	17.2
	31-40	52	7.4
	41+	3	0.4
Daysailers	8-15	2	0.3
	16-20	11	1.6
	21-25	10	1.4
	26+	1	0.1
		705	100.0

TABLE 6-6
RECREATIONAL FLEET PROJECTED FOR ISLAND END RIVER

Type of Craft	Length	Percent
Outboards	15-20	9
	20+	2
Sterndrive	15-20	3
	21-25	12
	26+	2
Inboards	15-20	1
	21-30	22
	31-40	12
	41-50	2
	51+	0
Cruising Sailboats	15-20	0
	21-30	21
	31-40	10
	41+	0
Daysailers	8-15	0
	16-20	3
	21-25	1
	26+	0

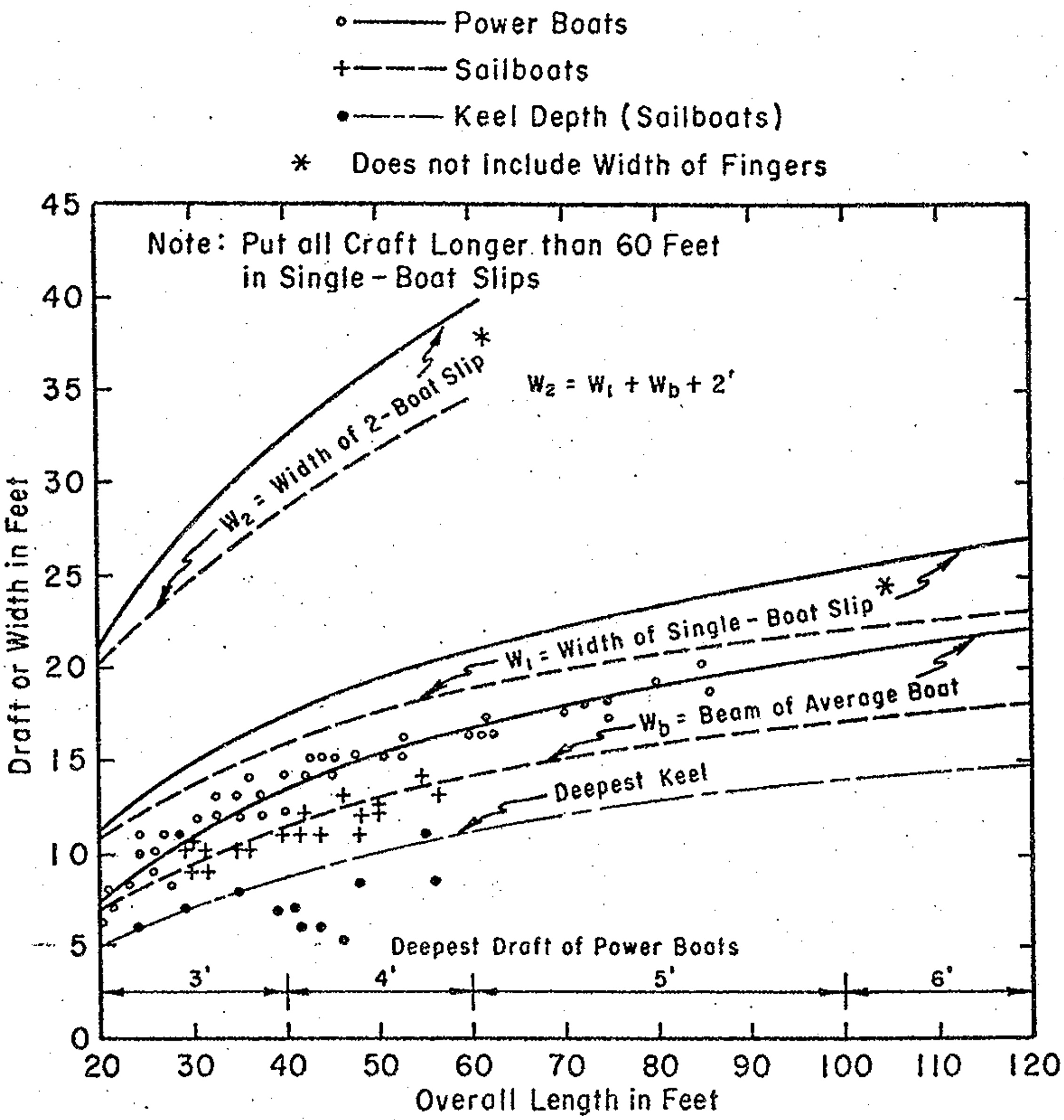
8. Actual return as a percentage of ideal return is dependent upon the type of boat. In general, the smaller, more maneuverable boats can utilize the harbor and river more effectively under all tide conditions. Boats with large drafts are more likely to be restricted to the channel and may be prevented from using the river at low tide conditions.

9. Figure 6-2 shows the criteria used to determine the required channel depth. Reductions in benefits are considered to occur if the draft exceeds the depth of water available at low tide. Table 6-7 shows the percent reductions in benefits estimated to occur with different channel depths.

10. Channel dimensions of 100 feet wide and 6 feet deep were selected as the most cost effective means of providing the desired boating. A "marginal" benefit/cost analysis of these design criteria is contained in Section B of this appendix. The following discussion of project benefits is based on this channel size.

11. Net benefits have been calculated by converting the future recreational benefits to an equivalent annual basis using an interest rate of 7-1/8 percent. This rate is currently applicable to all federal water resource projects.

12. Because of the conflict between recreational boats and large ships inherent in Plan A, recreational benefits are reduced for this plan. As shown in Table 6-8, the delay to recreational boats is estimated to reduce benefits by 7%, as compared to other alternatives.



SOURCE: SMALL CRAFT HARBORS: DESIGN CONSTRUCTION AND OPERATION
U.S. ARMY CORPS OF ENGINEERS, COASTAL ENGINEERING RESEARCH CENTER, 1974

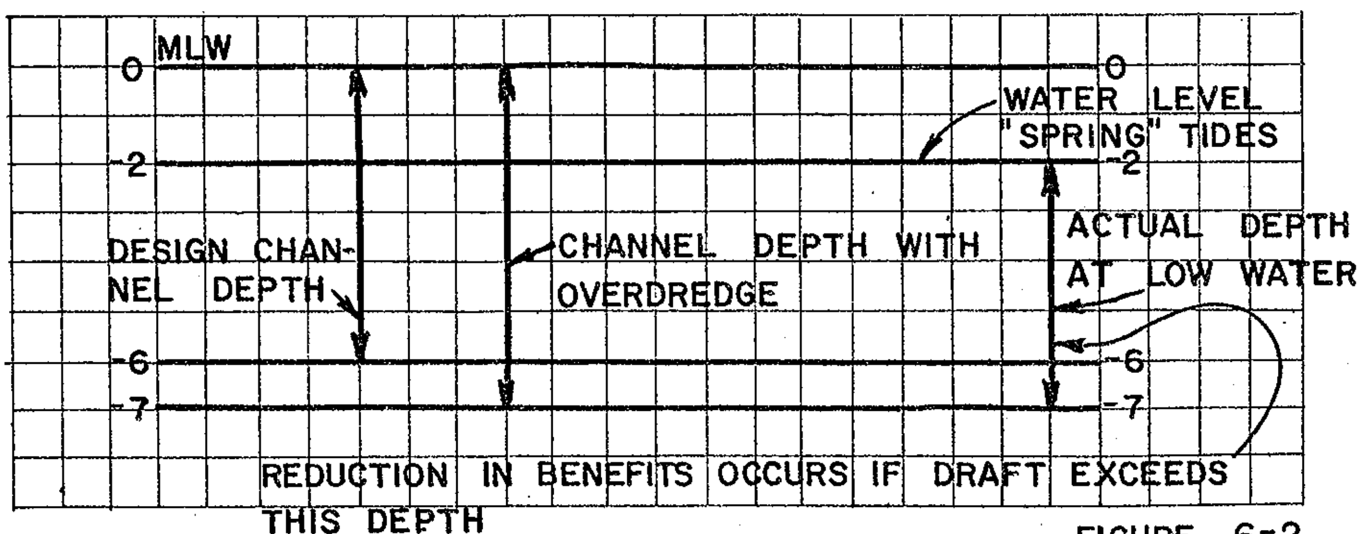


FIGURE 6-2

CHANNEL DEPTH CRITERIA

TABLE 6-7
ESTIMATED REDUCTIONS IN BENEFITS (% FROM IDEAL) BASED UPON DESIGN CHANNEL DEPTH (FEET)

Type of Craft	5'	6'	7'	8'
Outboards				
15-20	-	-	-	-
20+	-	-	-	-
Sterndrives				
15-20	-	-	-	-
21-25	-	-	-	-
26+	-	-	-	-
Inboards				
15-20	-	-	-	-
21-30	5	-	-	-
31-40	15	-	-	-
41-50	25	-	-	-
51+	35	15	-	-
Cruising Sailboats				
15-20	15	-	-	-
21-30	25	15	-	-
31-40	35	25	15	-
41+	45	35	25	
Daysailers				
8-15	-	-	-	-
16-20	15	-	-	-
21-25	25	15	-	-
26+	35	25	15	-

TABLE 6-8

REDUCTION IN BENEFITS DUE TO CONFLICT WITH INDUSTRIAL SHIPPING

COMPANY	SHIPS PER YEAR RECEIVED
1. Exxon Corp.	150
2. Coldwater Seafood	50
3. Marquette Cement	25
Total	225

1. 225 ships per year X 2 = 450 trips per year or 1.25 per day
2. Assuming 1 hour of delay for each industrial shipping movement: 1.25 hours of delay per 16 hour sailing day = 7%
3. Benefits of Plan A are reduced by 7%.

TABLE 6-9 BENEFITS TO RECREATIONAL BOATING*
BOATS ADDED IMMEDIATELY

HARBOR:

TYPE CF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	PERCENT RETURN Ideal	% of Ideal Pres.	% of Ideal Fut.	Gain	VALUE $	ON CRUISE Avg. Davs	ON CRUISE % of Season	ON CRUISE Value $
RECREATICNAL FLEET												
Cutboards	15-20	9	3,600	32,400	13		95	12.35	4,001			
	21&Up	2	6,550	13,100	13		95	12.35	1,618			
Sterndrive	15-20	3	5,850	17,550	11		95	10.45	1,834			
	21-25	12	9,200	110,400	11		95	10.45	11,536			
	26&Up	2	18,150	36,300	10		95	9.50	3,448			
Inboards	15-20	1	6,600	6,600	12		95	11.40	752			
	21-30	22	13,500	297,000	12		95	11.40	33,858	14	9	3,047
	31-40	12	36,950	443,400	11		95	10.45	46,335	19	12	5,560
	41-50	2	87,600	175,200	10		95	9.50	16,644	32	20	3,328
	51-Up	0	174,900	0	9		80	7.20	0	48	30	0
Cruising Sailboats	15-20	0	4,300	0	8		95	7.60	0			
	21-30	21	13,550	284,550	8		80	6.40	18,211	8	5	910
	31-40	10	37,350	373,500	7		70	4.90	18,302	26	16	2,928
	41&Up	0	73,800	0	5		60	3.00	0	40	25	0
Daysailers	8-15	0	1,200	0	12		95	11.40	0			
	16-20	3	2,950	8,850	12		95	11.40	1,009			
	21-25	1	5,500	5,500	11		80	8.80	484	8	5	24
	26&Up	0	10,550	0	10		80	8.80	0	40	25	0
TOTALS		100							$158,032			$15,797

Annual Benefits = $158,032 - 15,797 = $142,235

Annual Benefits (Plan A) = $142,235 x (.93) = $132,279

* Benefits based on recommended 100 foot width & 6 foot depth

TABLE 6-10 BENEFITS TO RECREATIONAL BOATING
BOATS ADDED IMMEDIATELY
TRANSIENT FLEET

HARBOR:

TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE $	ON CRUISE		
			Average $	Total $	Ideal	% of Ideal		Gain		Avg. Days	% of Season	Value $
						Pres.	Fut.					
RECREATIONAL FLEET												
Outboards	15-20	4	3,600	14,400	13		95	12.35	1,778			
	21&Up	1	6,550	6,550	13		95	12.35	809			
Sterndrive	15-20	1	5,850	5,850	11		95	10.45	611			
	21-25	4	9,200	9,200	11		95	10.45	3,847			
	26&Up											
Inboards	15-20											
	21-30											
	31-40											
	41-50											
	51-Up											
Cruising Sailboats	15-20											
	21-30											
	31-40											
	41&Up											
Daysailers	8-15											
	16-20											
	21-25											
	26&Up											
TOTALS		10							$7,045			

Annual Benefits = $7,045

Annual Benefits (Plan A) = $7,045x .93 = $6,551

TABLE 6-11 BENEFTIS TO RECREATIONAL BOATING*
BOATS ADDED WITHIN 10 YEARS

HARBOR:

TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE Average $	Total $	PERCENT RETURN Ideal	% of Ideal Pres.	Fut.	Gain	VALUE $	ON CRUISE Avg. Days	% of Season	Value $
RECREATIONAL FLEET												
Outboards	15-20	9	3,600	32,400	13		95	12.35	4,001			
	21&Up	2	6,550	13,100	13		95	12.35	1,618			
Sterndrive	15-20	3	5,850	17,550	11		95	10.45	1,834			
	21-25	12	9,200	110,400	11		95	10.45	11,536			
	26&Up	2	18,150	36,300	10		95	9.50	3,448			
Inboards	15-20	1	6,600	6,600	12		95	11.40	752			
	21-30	22	13,500	297,000	12		95	11.40	33,858	14	9	3,047
	31-40	12	36,950	443,400	11		95	10.45	46,335	19	12	5,560
	41-50	2	87,600	175,200	10		95	9.50	16,664	32	20	3,328
	51-Up	0	174,900	0	9		80	7.20	0	48	30	0
Cruising Sailboats	15-20	0	4,300	0	8		95	7.60	0			
	21-30	21	13,550	284,550	8		80	6.40	18.211	8	5	910
	31-40	10	37,350	373,500	7		70	4.90	18,302	26	16	2,928
	41&Up	0	73,800	0	5		60	3.00	0	40	25	0
Daysailers	8-15	0	1,200	0	12		95	11.40	0			
	16-20	3	2,950	8,850	12		95	11.40	1,009			
	21-25	1	5,500	5,500	11		80	8.80	484	8	5	24
	26&Up	0	1-,550	0	10		80	8.00	0	40	25	0
TOTALS		100							$158,032			$15,797

1. After 10 years:
   Annual benefits (per 100 boats) = $158,032-$15,797 = $142,235
   Annual benefits (per 150 boats) = 1.5 x 142,235 = $213,353

2. Equivalent annual benefits = $213,353 x .739722 = $157,822

3. Equivalent annual benefits (Plan A) = $157,822 x (.93) = $146,774

* Benefits based on recommended 100 foot width and 6 foot depth.

TABLE 6-12 BENEFITS TO RECREATIONAL BOATING
BOATS ADDED WITHIN 10 YEARS
TRANSIENT FLEET

HARBOR:

TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	PERCENT RETURN Ideal	% of Ideal Pres.	% of Ideal Fut.	Gain	VALUE $	ON CRUISE Avg. Days	% of Season	Value $
RECREATIONAL FLEET												
Outboards	15-20	8	3,600	28,800			95	12.35	3,557			
	21&Up	2	6,550	13,100			95	12.35	1,618			
Sterndrive	15-20	2	5,850	11,700			95	10.45	1,223			
	21-25	8	9,200	73,600			95	10.45	7,691			
	26&Up											
Inboards	15-20											
	21-30											
	31-40											
	41-50											
	51-Up											
Cruising Sailboats	15-20											
	21-30											
	31-40											
	41&Up											
Daysailers	8-15											
	16-20											
	21-25											
	26&Up											
TOTALS		20							$14,089			

1. Annual Benefits after ten years = $14,089.

2. Equivalent annual benefits = $14,089 x .739722 = $10,422.

3. Equivalent annual benefits (Plan A) = $10,422 x .93 = $9,693.

13. Construction of the proposed marina is anticipated to take place in stages, reflecting the construction of residential housing on the former Naval Hospital site. Within 2 years after completion of the federal project, it is estimated that marina facilities for 100 boats would be provided. The use of the Island End River by the 100 boats based at the marina would produce net recreational benefits of $132,279 for Plan A an $142,235 for Plans B, C and D (See Table 6-9).

14. In addition to the 100 boats berthed at the marina, an average of 10 boats per day are estimated to use the marina facilities as transient vessels, or to be launched for day use. These craft are anticipated to be outboards or stern drive boats. Annual net benefits of $6551 for Plan A and $7045 for Plans B, C and D are estimated for these boats (See Table 6-10).

15. Based upon the increasing population at the Naval Hospital site and in general upon the continued growth in demand for mooring spaces in the greater Boston area, the marina facilities are projected to be expanded to provide a capacity of 250 mooring spaces within a ten year period. A marina with a capacity of 250 boats has been proposed in the City of Chelsea's Redevelopment Master Plan for the Naval Hospital. Benefits from the additional boats added within the ten year period are estimated at $146,774 for Plan A and $157,822 for Plans B, C and D (See Table 6-11).

16. Transient and launched boats are anticipated to increase from an average of 10 per day to an average of 20 per day with a ten year period. Annual net benefits of $9693 and $10,422 are estimated for these crafts (See Table 6-12).

17. Project benefits are summarized in Table 6-13. Plan A results in total equivalent annual benefits of $295,300. Plans B, C and D have equivalent annual benefits of $317,500.

Table 6-13
PROJECT BENEFITS
(EQUIVALENT ANNUAL BENEFITS)

	PLAN A	PLANS B, C, D
BOATS ADDED IMMEDIATLEY		
1. Moored Boats	$132,279	$142,235
2. Transient Boats	6,551	7,045
BOATS ADDED WITHN 10 YEARS		
1. Moored Boats	$146,774	$157,822
2. Transient Boats	9,693	10,422
Total Benefits	$295,297	$317,525
SAY:	$295,300	$317,500

COST ESTIMATES

18. Detailed cost estimates for each alternative have been presented in Appendix 2, Tables 2-2, 2-4, 2-6, and 2-8. These cost estimates have been based on the following factors:

Price per cubic yard for dredging
Price per linear foot for revetment
Constructon contingencies (15%)
Engineering (7%)
Supervision and Administration (8%)

Appendix 4, Sections D and E contain an explanation of the method of determining dredging prices.

SUMMARY

19. Table 6-14 contains a summary of the project costs and benefits for each alternative. Each plan will result in benefit/cost ratios greater than 1.0 and will result in positive net benefits. Plan B, the selected plan, will result in the greatest net benefits.

Table 6-14
SUMMARY OF ECONOMIC ANALYSIS

	PLAN	A	B	C	D
1.	Annual Cost	$ 57,000	$68,000	$95,000	$115,000
2.	Annual Benefits	$ 295,300	$317,500	$317,500	$317,500
3.	BenefitCost Ratio	5.2	4.7	3.3	2.8
4.	Net Benefits	$ 238,300	$249,500	$222,500	$202,500

SECTION B

ANALYSIS OF ALTERNATIVE CHANNEL DIMENSIONS

20. Following the designation of the selected plan, further analysis of the proposed channel dimensions were undertaken in order to ensure that the proposed plan represented the plan producing the maximum net benefits. Therefore, "marginal" benefit/cost calculations were made to determine the changes in net benefits with changes in channel dimensions.

CHANNEL DEPTHS

21. Figure 6-2 illustrates the criteria used to evaluate channel depths. Table 6-7 shows the reductions in benefits assumed to occur with differing channel depths. Based on Table 6-7, benefits have been evaluated for channel depths of 5, 6, and 7 feet. These are shown in Tables 6-15, 6-16 and 6-17 respectively. The results are based on the fleet mix expected to occur in the Island End River and are shown in terms of the average benefit per boat.

22. Table 6-18 shows the differences in project benefits and costs associated with 5, 6 and 7 foot channel depths.

TABLE 6-15 BENEFITS TO RECREATIONAL BOATING

PLAN B (5 FOOT DEEP CHANNEL)

HARBOR:

TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE: Average $	Total $	PERCENT RETURN Ideal	% of Ideal Pres.	Fut.	Gain	VALUE $	ON CRUISE Avg. Days	% of Season	Value $
RECREATIONAL FLEET												
Outboards	15-20	9	3,600	32,400	13		95	12.35	4,001			
	21&Up	2	6,550	13,100	13		95	12.35	1,618			
Sterndrive	15-20	3	5,850	17,550	11		95	10.45	1,834			
	21-25	12	9,200	110,400	11		95	10.45	11,536			
	26&Up	2	18,150	36,300	10		95	9.50	3,448			
Inboards	15-20	1	6,600	6,600	12		95	11.40	752			
	21-30	22	13,500	297,000	12		90	10.80	32,076	14	9	2,887
	31-40	12	36,950	443,400	11		80	8.80	39,019	19	12	4,682
	41-50	2	87,600	175,200	10		70	7.00	12,264	32	20	2,453
	51-Up	0	174,900	0	9		60	5.40	0	48	30	0
Cruising Sailboats	15-20	0	4,300	0	8		80	6.40	0			
	21-30	21	13,550	284,550	8		70	5.60	15,934	8	5	796
	31-40	10	37,350	373,500	7		60	4.20	15,687	26	16	2,510
	41&Up	0	73,800	0	5		50	2.50	0	40	25	0
Daysailers	8-15	0	1,200	0	12		75	11.40	0			
	16-20	3	2,950	8,850	12		80	9.60	850			
	21-25	1	5,500	5,500	11		70	7.70	423	8	5	21
	26&Up	0	10,550	0	10		70	7.00	0	40	25	0
TOTALS									139,442			13,349

Annual Benefits (per 100 boats) = $139,442 - $13,349 = $126,093.

TABLE 6-16 BENEFITS TO RECREATIONAL BOATING

PLAN B (6 FOOT DEEP CHANNEL)

HARBOR:

TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE $	ON CRUISE		
			Average $	Total $	Ideal	% of Ideal Pres.	% of Ideal Fut.	Gain		Avg. Days	% of Season	Value $
RECREATIONAL FLEET												
Outboards	15-20	9	3,600	32,400	13		95	12.35	4,001			
	21&Up	2	6,550	13,100	13		95	12.35	1,618			
Sterndrive	15-20	3	5,850	17,550	11		95	10.45	1,834			
	21-25	12	9,200	110,400	11		95	10.45	11,536			
	26&Up	2	18,150	36,300	10		95	9.50	3,448			
Inboards	15-20	1	6,600	6,600	12		95	11.40	752			
	21-30	22	13,500	297,000	12		95	11.40	33,858	14	9	3,047
	31-40	12	36,950	443,400	11		95	10.45	46,335	19	12	5,560
	41-50	2	87,600	175,200	10		95	9.50	16,644	32	20	3,328
	51-Up	0	174,900	0	9		80	7.20	0	48	30	0
Cruising Sailboats	15-20	0	4,300	0	8		95	7.60	0			
	21-30	21	13,550	284,550	8		80	6.40	18,211	8	5	910
	31-40	10	37,350	373,500	7		70	4.90	18,302	26	16	2,928
	41&Up	0	73,800	0	5		60	3.00	0	40	25	0
Daysailers	8-15	0	1,200	0	12		95	11.40	0			
	16-20	3	2,950	8,850	12		95	11.40	1,009			
	21-25	1	5,500	5,500	11		80	8.80	484	8	5	24
	26&Up	0	10,550	0	10		80	8.00	0	40	25	0
TOTALS		100							158,032			15,797

1. Annual benefits (per 100 boats) = $158,032 - $15,797 = $142,235.

TABLE 6-18

ECONOMIC ANALYSIS OF CHANNEL DEPTHS

	Channel Depth 5	6	7
ANNUAL PROJECT BENEFITS			
A) Boats Added Immediately			
1. Moored Boats	$126,093	$142,235	$147,760
2. Transient Boats	7,045	7,045	7,045
B) Boats Added Within 10 Years			
1. Moored Boats	139,911	157,822	163,952
2. Transient Boats	10,422	10,422	10,422
Total	$283,471	$317,524	$329,178
ANNUAL PROJECT COSTS			
A) Amortization	$ 37,600	$ 44,900	$ 53,200
B) Maintenance	15,300	19,400	23,700
Total Annual Cost	$ 52,900	$ 64,300	$ 76,900
ANNUAL NET BENEFITS	$ 230,571	$253,224	$252,278

CHANNEL WIDTH

23. A channel width of 100 feet has been selected based on a consideration of convenience and safety to boaters. At the upper end of the project, the channel serves to provide access to the marina as well as serving as a maneuvering and turning area. A width of the turning area equal to twice the length of the largest boat is considered to be the minimum allowable width for adequate maneuvering. Since boats up to 50 feet long are expected, a minimum width of 100 feet is required adjacent to the marina.

24. Downstream of the marina, the existing channel will be widened by dredging up to 80 feet of additional width. However, the channel will be clearly marked to designate a 100 foot wide small boat channel.

25. Reduction of the proposed channel width will result in additional congestion within the small boat channel as well as a smaller separation between the recreational boats and the large ships. This will lead to a reduction in the recreational benefits.

26. Elimination of the proposed widening of the commercial channel is the same as Plan A. This would result in a reduction in benefits of 7%. Therefore, narrowing of the proposed width of 100 feet would produce reductions in benefits ranging up to 7%.

27. On the average with a 100 foot wide channel the eastern edge of the small boat channel would be about 40 feet from the deeper water of the commercial channel. With an 80 foot wide channel, the eastern edge would be about 20 feet away. Therefore, a reduction of 3-1/2% was assumed to occur within an 80 foot wide channel. No additional benefits were assumed to occur with a 120 foot wide channel.

28. The following table shows the estimated costs and benefits for alternative channel width.

Table 6-19
ANALYSIS OF ALTERNATIVE CHANNEL WIDTHS PLAN B

	Channel Widths		
	80	100	120
Annual Cost	$ 57,100	$64,300	$ 71,600
Annual Benefits	$306,400	$317,500	$317,500
Annual Net Benefits	$249,300	$253,200	$245,900

APPENDIX 7

ANALYSIS OF DISPOSAL OF DREDGED MATERIAL

APPENDIX 7

ANALYSIS OF DISPOSAL OF DREDGED MATERIAL

APPENDIX 7

ANALYSIS OF DISPOSAL OF DREDGED MATERIALS

1. This appendix identifies and evaluates various feasible methods for disposal of dredged materials. Three options appear to be feasible : the option of ocean disposal, the option of disposal on land at a site on the shores of the Chelsea Naval Hospital, and disposal in a landfill at the site of the proposed Container Port facility in South Boston.

2. The option of disposal at a land fill site in the City of Cheslea removed from the Island End River or elsewhere in eastern Massachusetts is not considered feasible. There is no landfill site in the City of Chelsea capable of receiving the material. In addition, beacuse the material contains high amounts of pollutants, it is regarded as a toxic substance. The Massachusetts Department of Environmental Quality Engineering has indicated that there is no landfill area in eastern Massachusetts currently approved to receive toxic materials. Even if a suitable landfill site could be found for disposal of dredged materials, it is anticipated that the transport of large quantities of dredged materials to a distant site would cause significant adverse impacts.

3. The option of selling or donating the dredged materials for use as structural fill for most types of construction projects is not considered feasible. The upper strata are generally believed to have poor structural properties. Lower strata particularly on the easterly shore of the river generally are of a granular nature, however, stratified dredging would add to removal costs. Additionally, disposal of lower strata for structural fill would not solve the problem of disposal of the structurally unsuitable upper strata.

4. Massport is currently proposing construction of a major container port facility at the site of the former South Boston Naval Annex. An approximately 40 acre site will be filled to accomodate the loading cranes and container storage facilities. While the dredged material from the Island End River is not ideal fill due to its poor structural properties, other poor quality fill will be placed in the area. Massport plans to dredge the bottom sediments adjacent to the site to create deepwater berths. Additionally, the existing bottom sediments in the container port will not be removed prior to filling. Although no information is available on subsurface conditions at the Massport site, it is probable that the structural properties of the material from the Island End River will be no worse than materials already slated for deposition in the landfill site. Massport plans to obtain fill from various construction projects in the Boston area including the M.B.T.A. red line tunnel excavations. However, there will be ample room to accomodate the volume of materials from the Island End River.

5. The Massport site would be suitable as a disposal site for dredged materials. It is close to the Island End River which would minimize transport costs. Access by water is available which would minimize transport impacts. The feasibility of using the site is based upon scheduling, the properties of the dredged materials, and the acquiescence of Massport.

6. The extent of design development for the proposed container port is limited. The schedule of implementation is similarly uncertain. It is currently estimated that fill will be accepted no earlier than 1982 or 1983. Thus, the Island End River improvements might have to be delayed if the Massport site is to be used.

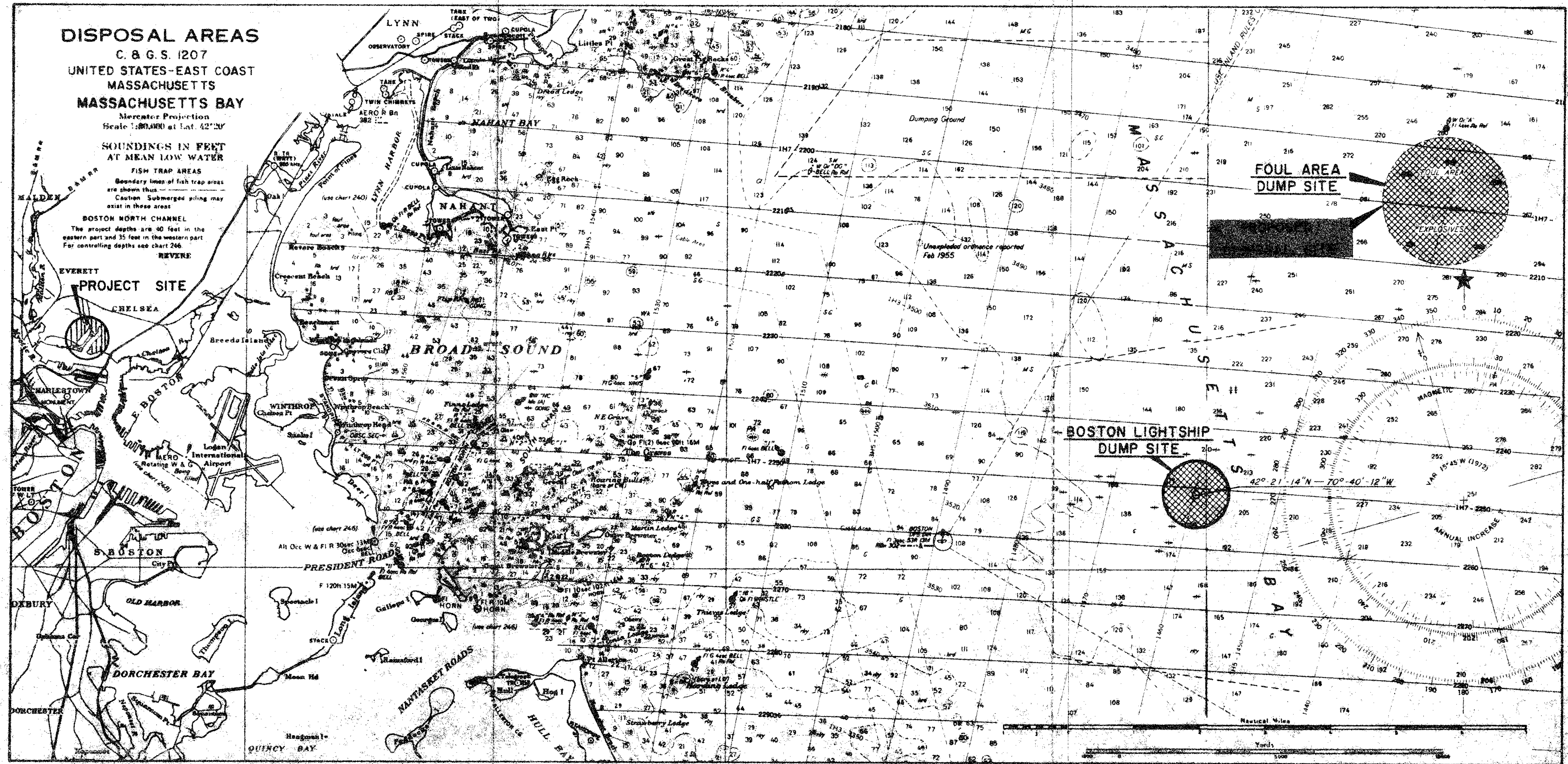
7. Massport will design appropriate containment, sedimentation and leachate treatment facilities to accommodate proposed fill materials. If the dredged materials from the Island End River were different from the other fill then a pretreatment or modification of the above facilities might be required. The additional expense of facility modification might lead Massport to reject material from the Island End River.

8. The Boston Foul Area is the only location off the Massachusetts coast where the ocean disposal of dredged materials is permitted. It is located approximately 24 nautical miles from the Island End River. The area contains two sites: the Marblehead site which is designated for the discharge of dredged materials and the Boston site which is designated for the discharge of all other waste materials. Both sites are circular areas having a radii of approximately one mile each. The Marblehead site would be used for the disposal of dredged materials from the Island End River. See Figure 7-1.

9. The ocean floor of the Boston Harbor is characterized by a thick layer of fine grained silty-clay sediments which have been accumulating at a rate of less than 1 mm/year since the retreat of the last glacier. The Marblehead site, is located in the Stellwagen Basin. Sedimentation rates are the highest here because the basin acts as a receptacle for sediments.

The currents at all depths in the Boston Foul Area fluctuate considerably in both direction and speed seasonally with the bottom currents being consistently weaker than those measured at mid-depth and near the surface. Along the sea floor the residual drift is southeasterly in January, consistently westerly during June, mostly easterly in September, and variable but somewhat northly in October. The character of the currents and sediments in this area show that discharge of silty/clay dredge material will tend to remain suspended in the water and cause little erosion over time.

10. Although the water quality of the Boston Harbor meets current state and federal standards, there is a measurable deposit of materials on the bottom of the Harbor from the effluent discharge of sewage treatment plants containing elevated levels of heavy metals, PCB's, and a complex mixture of hydrocarbons resembling heavy lubrication oil. The concentrations of heavy metals and hydrocarbons are relatively high in the Boston Foul Area in comparison to other areas in Boston Harbor. According to a 1976 study of the Distribution of Polluted Materials in Massachusetts Bay by the New England Aquarium, it would be tempting to assign the higher concentrations near the Foul Area to the dispersion of polluted dredge spoil dumped there in recent years, especially since the net residual drift of bottom currents is shoreward and toward the Foul Area. However, a second factor may contribute to the distribution patterns displayed here. The regions of highest metal and hydrocarbon content are also those with the deepest deposits of silt and clay. The sedimentation rates evidenced by the depth of existing deposits indicates that these areas may be natural sinks for both polluted



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and unpolluted suspended solids entering Massachusetts Bay.

11. The offshore benthic population in the fine-grained substrates of Massachusetts Bay can best be characterized as a spio filicornisthyosira (gouldi) community. In the Boston Foul Area, the number of species and individuals are relatively depressed as compared with the entire area. Since this is not biologically productive, the dumping of dredge materials here is considered to be less environmentally damaging than disposal elsewhere.

12. An analysis of bottom sediments from the Island End River classified the material as "black, oily, fine sandy clay with strong petroleum odor and fibrous organics." The sediments exhibit a high percentage of grain sizes classified as "fine" and also high water contents. This indicates that the material is likely to disperse somewhat when dumped at sea, rather than settling rapidly to the bottom.

13. The chemical analysis of the bottom sediments indicated that the solids are polluted with fairly high levels of heavy metals, such as zinc, lead and mercury. The elutriate tests, which determine the chemical concentrations in the liquid phase, generally are more significant in terms of indicating potential environmental impacts. The pollutants contained in the elutriate are more likely to be ingested by marine organisms and enter the food chains. A detailed analysis of the chemical pollutants in the liquid phase, and their relationship to applicable water quality criteria is presented in Appendix 8.

14. Specific standards must be attained before a permit can be obtained for ocean disposal of dredge materials. Section 103 of the Marine Protection Reseach and Sanctuaries Act of 1972 (Public Law 92-532) requires that any proposed dumping of dredged material into ocean waters must be evaluated to determine its potential environmental effects on marine organisms. Appendix 5-C contains the detailed bioassay report entitled Ecological Evaluation of Proposed Oceanic Discharge of Dredged Material from Island End River, Chelsea, Massachusetts.

15. The bioassay is conducted by determining the effects of a liquid phase, a suspended particulate phase and a solid phase from the dredged sediments on the mortality rates of marine animals. The mortality rates occurring in the dredge samples are compared to those occurring with control samples to determine if disposal of the dredge material will have adverse ecological effects.

The bioassay conducted for the Island End River indicated that the liquid phase and the suspended particulate phase samples from the dredge material were not significantly different from the control samples. The solid phase, however, in the first evaluation appeared to have a significantly different effect than the control sediments.

16. The dredge material sample had a significant effect on the mortality of mysid shrimp as compared to the control sample. It was believed that the high mortality of the shrimp was due to the effects of fine particles clogging their gills. The control sample consisted of clear sand, in comparision to the silty mud of the dredge sample, and therefore, did not have this effect on the shrimp.

17. The original solid phase bioassay results were inconclusive, because of differences between the test control sediments and the sediments found at the proposed disposal site. The control samples consisting of clean sand were quite different from the actual bottom sediments at the disposal site. The solid phase bioassay was repeated using control samples from the disposal site. This test indicated that there was not a significant difference in between Island End River sediments and the control sediments. The Island End River dredged material was therefore judged to be ecologically acceptable for ocean disposal.

18. Ocean disposal would have a lower economic cost than land disposal, Secondary impacts relating to transport would be minimal when compared to any alternative involving trucking dredged materials for substantial distances.

19. Land disposal would limit the development potential of the land disposal site due to the poor structural properties of the dredged material. Therefore, ocean disposal is considered preferable. Land disposal of dredged material is feasible although less desirable than ocean disposal for a number of economic and environmental reasons. In the case of the Island End River, the following factors must be considered:

- The upper layer of river bottom sediments consists of highly organic mud. When this is placed on land to dry, anaerobic decomposition of organic material is likely to give off objectionable odors. Thus, it is undesirable to dispose of the material near populated areas.

- Dredge materials would be characteristically clayey and silty and would form poor quality landfill subject to substantial consolidation.

  It would have poor bearing capacities without substantial soil improvement efforts.

- High concentrations of heavy metals such as lead, zinc and mercury in the upper layers, as well as high concentrations of oil residues would result in pollution of ground and surface water.

Massachusetts Department of Environmental Quality Engineering regulations require that dredge materials with physical and chemical properties compatable to those found in the Island End River be placed in sites contained by dikes or bulkheads. Weir effluent must also be controlled. The disposal site must be designated by the local Board of Health. Depending on the nature of the pollutants, DEQE may also place other condidtions on the disposal method.

20. Discussions with DEQE indicate that there are no communities in the area of the project having sanitary landfills that meet the present criteria for disposal of polluted waste. No communities other than Chelsea are likely to be willing to designate a disposal area for the wastes from this project. Because Chelsea is urbanized, finding a suitable location for such a site would be difficult.

21. Disposal of dredgings adjacent to the Island End River presents a number of problems. Because of the proposed MDC park, the only possible land disposal site would be at the marina development site. Figures 7-2 and 7-3 show the existing and proposed land uses at this location. Disposal of dredged materials here would raise the elevation of the marina parking lot and work yard area, and would provide poor soil foundation conditions for roads, parking lots and buildings. Although capacity and cost of constructing a land disposal area for dredged materials are dependent on existing subsurface characteristics of the site, no site specific soils information is available. While present soil conditions in the proposed disposal area are not known, the City of Chelsea feels that the eastern portion of the area designated for industrial and commercial development presently provides good foundation conditions for construction. However, the western part of the site in the area of the proposed marina parking lot was apparently used at one time as a dump. Therefore, in this area, subsurface conditions are likely to be poor and very little good borrow is likely to be available for construction of retaining dikes.

22. The land disposal area must be capable of handling the spoils from the marina basin as well as from the channel dredging if ocean disposal is ruled out. Volumes for the channel dredging range from 51,800 to 110,100 cubic yards while the marina basin and boat launching ramps would require dredging of approximately 64,900 cubic yards. For the tentatively selected Plan B, the channel provides 64,100 cubic yards, virtually the same as for the marina basin.

23. If dredging of the marina basin were to take place one or two years after the channel dredging a staged disposal method could be used. After the channel dredging spoils have sufficiently dewatered, they may be excavated and the diked area used to dewater the marina basin dredged materials. Double use of the diked area would reduce the size and cost of construction of the area offsetting the double mobilization cost involved in staged dredging.

24. Three alternative land disposal plans have been evaluated. These are described below. It should be noted that the costs are for the shore work only and do not include the costs of placing the dredged material into the diked basins.

25. Alternative 1 is illustrated in Figure 7-4. A triangular basin would be constructed in the area north of the proposed Road "A" which is to be constructed as part of the Chelsea Naval Hospital redevelopment. The top of the dike would have to be built up to about elevation 38, providing a capacity of 65,000 cubic yards in the basin. A total of 46,000 cubic yards of embankment fill would be required to construct the retaining dikes, of this amount, only about 10,000 cubic yards would be available from local borrow pits.

26. Dredged material could be disposed of in two stages. After the channel material has dewatered sufficiently, it could be excavated and placed in areas to the south and east of Road "A". The retention basin could then be used again to dewater the material dredged from the marina basin. The following is a preliminary cost estimate of this disposal option.

Table 7-1
Projected Land Disposal Costs

Locally Available Borrow	10,000 c.y. @ $1.00 =	$10,000
Additional Fill	35,000 c.y. @ 4.00 =	140,000
Effluent weir and flume Site Work		15,000
Subtotal		$165,000
Rehandling of first stage dredgings 65,000 yds @ $1.00	=	65,000
Capping layer over second stage 8,000 yds @ $4.00	=	32,000
Total		$262,000

27. Alternative 2, shown in Figure 7-5, provides for the disposal of the total amount of dredged material from the Plan B channel and the marina basin in an area north of Road "A". This would require bulkheading a low marshy area to the north of the marina site, as well as the construction of retaining dikes as in Alternative 1. The tops of the dikes would have to be brought up to elevation 43.

28. For the purposes of this preliminary evaluation it has been assumed that subsurface conditions are such that such large dikes and bulkheads could feasibly be constructed in this area. It is possible that subsurface conditions could limit the size and location of the retaining dikes proposed in Alternatives 1 and 2. Should the land disposal option be considered in detail in the future, these factors would have to be investigated in more detail.

29. The following is a cost estimate for Alternative 2:

Table 7-2
Projected Land Dispoal Costs
Alternate 2

Available borrow 10,000 c.y. @ $1.00	=	$10,000
Other fill 60,200 c.y. @ $4.00	=	240,000
Bulkheads 560 L.F.	=	140,000
Effluent Weir & Flume and Site Work	=	15,000
Capping Layer 12,000 c.y. @ $4.00	=	48,000
Total		$453,000

30. Alternative 3 is illustrated in Figure 7-6. This alternative would require the relocation of proposed Roads "A" and "B" as shown. The existing road would have to be temporarily deadended near Building 2. After the dredged material has consolidated, Roads "A" and "B" could be constructed as planned although their construction costs would be considerably higher since preconsolidation may be required.

31. Alternative 3 spreads the dredged materials over a much larger area, consequently the necessary retaining dikes are much lower. Because the borrow area is extended into the hillside where gravel like material is more likely to be found, it appears that retaining dikes could be constructed

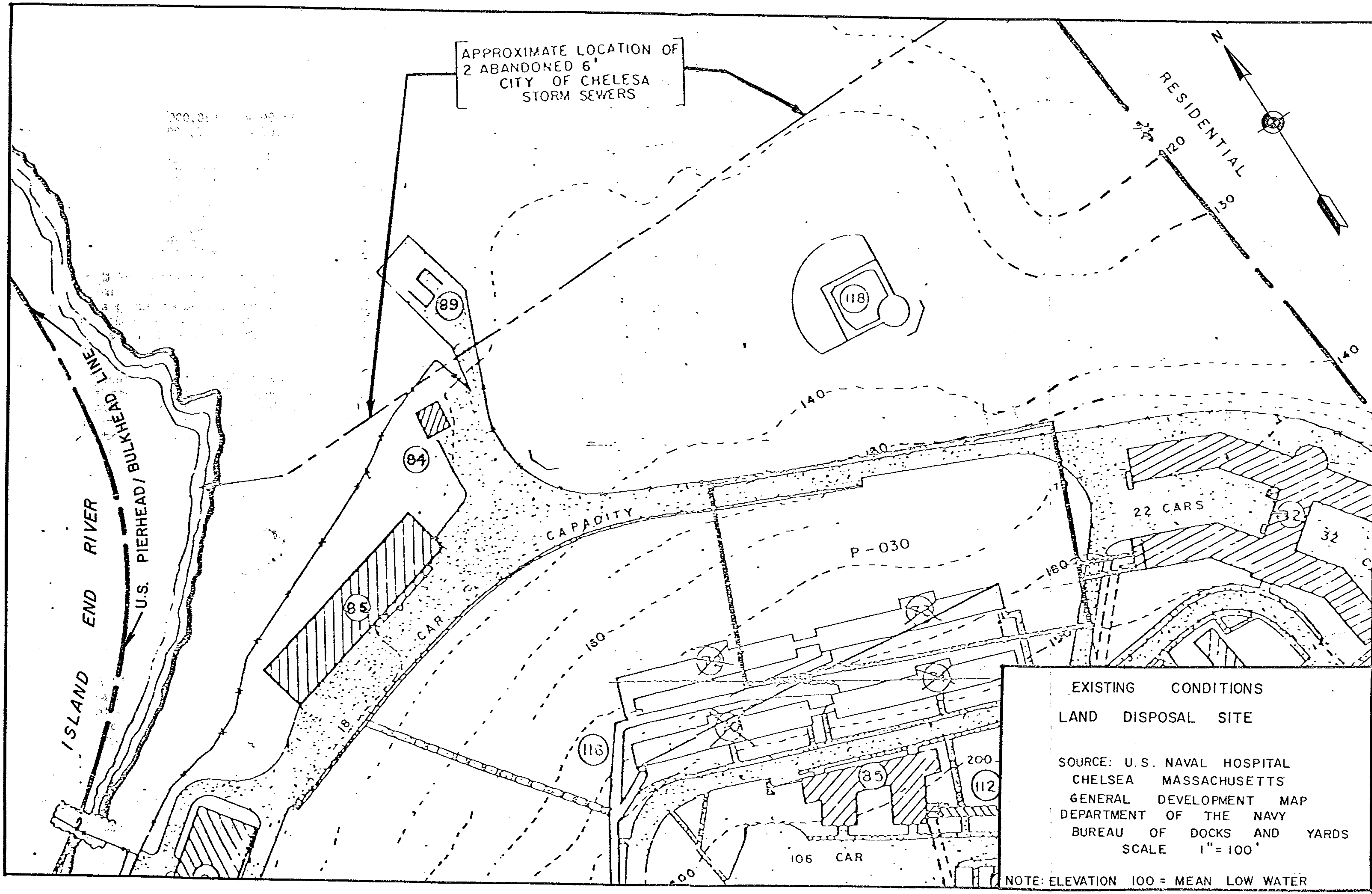

APPROXIMATE LOCATION OF
2 ABANDONED 6'
CITY OF CHELESA
STORM SEWERS
RESIDENTIAL
N
ISLAND END RIVER
U.S. PIERHEAD/ BULKHEAD LINE
CAR CAPACITY
P - 030
22 CARS
106 CAR
89
84
85
118
116
112
32
EXISTING CONDITIONS
LAND DISPOSAL SITE
SOURCE: U.S. NAVAL HOSPITAL
CHELSEA MASSACHUSETTS
GENERAL DEVELOPMENT MAP
DEPARTMENT OF THE NAVY
BUREAU OF DOCKS AND YARDS
SCALE 1" = 100'
NOTE: ELEVATION 100 = MEAN LOW WATER

FIGURE 7-2

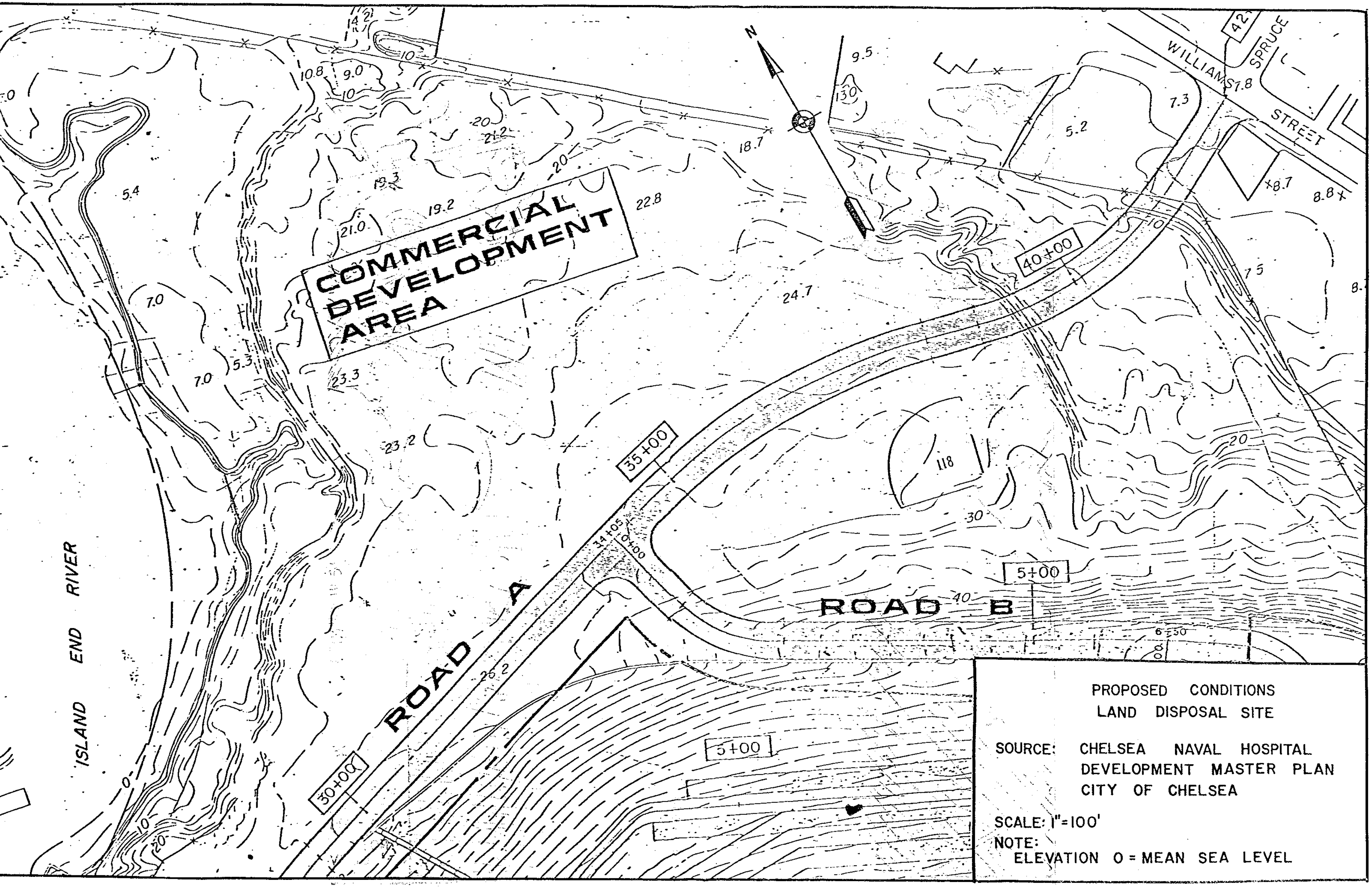

COMMERCIAL DEVELOPMENT AREA
ROAD A
ROAD B
ISLAND END RIVER
WILLIAMS STREET
SPRUCE
N
40+00
35+00
30+00
34+05
0+00
5+00
6+30
PROPOSED CONDITIONS
LAND DISPOSAL SITE
SOURCE: CHELSEA NAVAL HOSPITAL
DEVELOPMENT MASTER PLAN
CITY OF CHELSEA
SCALE: 1"=100'
NOTE:
ELEVATION 0 = MEAN SEA LEVEL

FIGURE 7-3

from available borrow. The tops of the dikes would be at about elevation 29. Costs of Alternative 3, not including additional road construction costs, are as follows:

Table 7-3
Projected Land Disposal Costs
Alternative 3

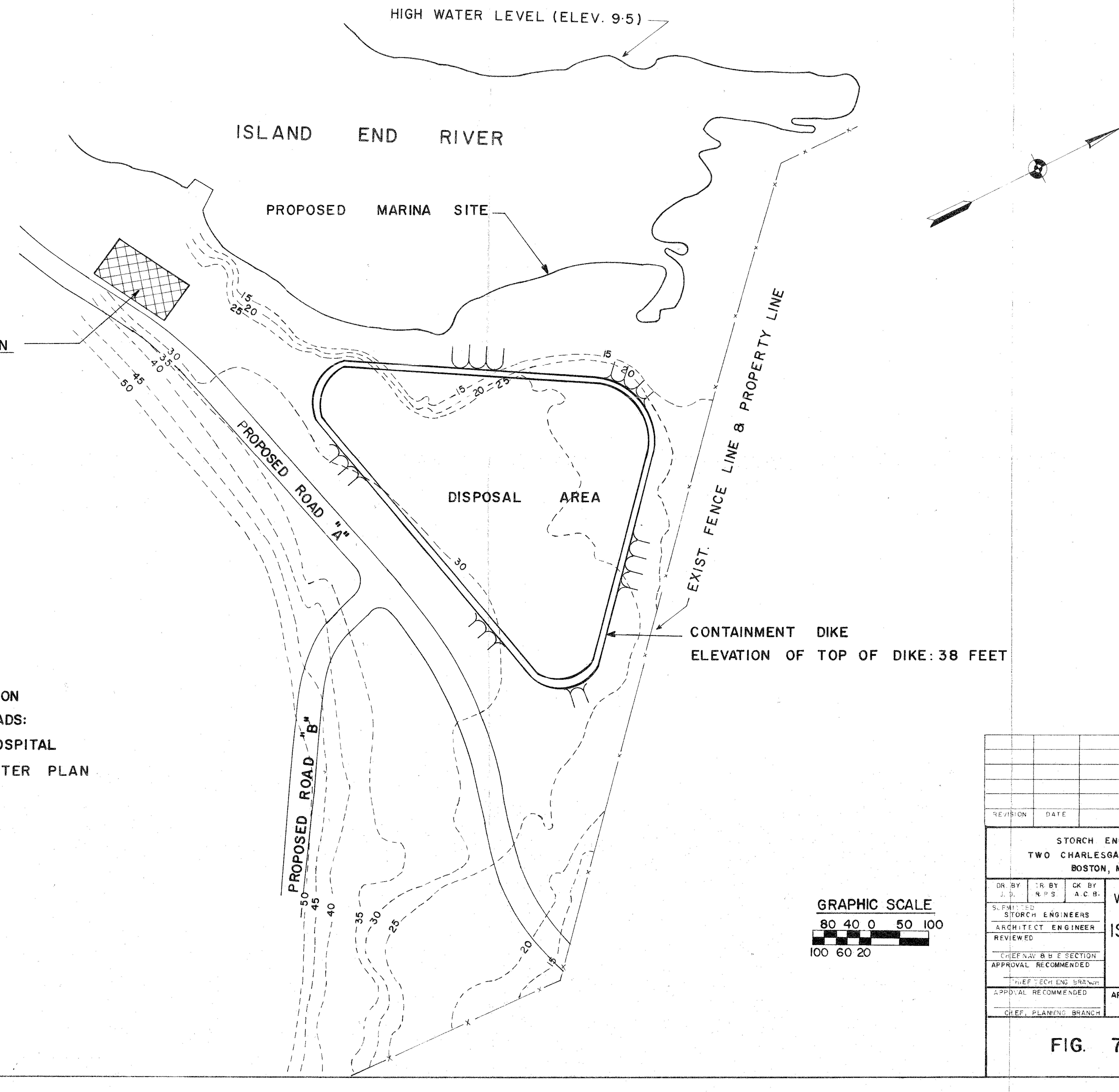
Locally Available borrow 36,000 c.y. @ $1.00	=	$36,000
Effluent Weir and Flume & Site Work	=	15,000
Capping Layer 27,000 c.y. @ $1.00	=	27,000
Total		$78,000

32. These alternatives would require placing dredgings (poor structural fill) over an area where marina parking and service buildings are proposed. Although the existing subsurface conditions are not defined a layer of loose organic fill would certainly add to subsequent development costs. Alternative 1, in particular, would greatly increase the cost of developing the proposed industrial site adjacent to the marina and would make development of the marina site difficult. The marina parking lot area would be left at an elevation of more than 40 feet above low water and the area of the proposed boat launching ramp would be more than 20 feet above MLW. Development of the industrial site is somewhat more feasible with Alternative 2, although some regrading would be needed and building foundation costs would be increased.

33. Alternative 3 provides for disposal of all the dredge spoils at a cost competitive with ocean dumping and leaves most of the area at an elevation of only about 5 feet above existing.

34. However, this alternative would have a major impact on the proposed Naval Hospital roadway circulation plan. Road "A" would have to be relocated and regraded on the hill at steep grade (about 10%). Presumably, the roadway system could be constructed as planned after the dredged material has been consolidated.

35. In summary, disposal of dredged materials at the porposed containment facility in South Boston is economically and environmentally feasible if permission can be obtained from Massport and if the respective schedules of the two projects can be coordinated. Although both are feasible, ocean dumping appears preferable to land dispoal from the point of view of costs and compatiblity with City of Chelsea development plans for the Naval Hospital site. If the option of land disposal for dredged materials is selected, the City of Chelsea must undertake a more detailed analysis of land disposal in conjunction with the development of plans for the marina and industrial site.



NOTE:

ALL ELEVATIONS REFER TO MEAN LOW WATER.

SOURCE OF LOCATION OF PROPOSED ROADS: CHELSEA NAVAL HOSPITAL DEVELOPMENT MASTER PLAN

REVISION	DATE	DESCRIPTION	BY

STORCH ENGINEERS
TWO CHARLESGATE WEST
BOSTON, MASS.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS

DR. BY	TR. BY	CK. BY
J. D.	R. P. S.	A. C. B.

SUBMITTED STORCH ENGINEERS
ARCHITECT ENGINEER
REVIEWED
CHIEF NAV & B E SECTION
APPROVAL RECOMMENDED
CHIEF TECH ENG BRANCH
APPROVAL RECOMMENDED
CHIEF, PLANNING BRANCH

WATER RESOURCES IMPROVEMENT STUDY

ISLAND END RIVER- CHELSEA, MA.

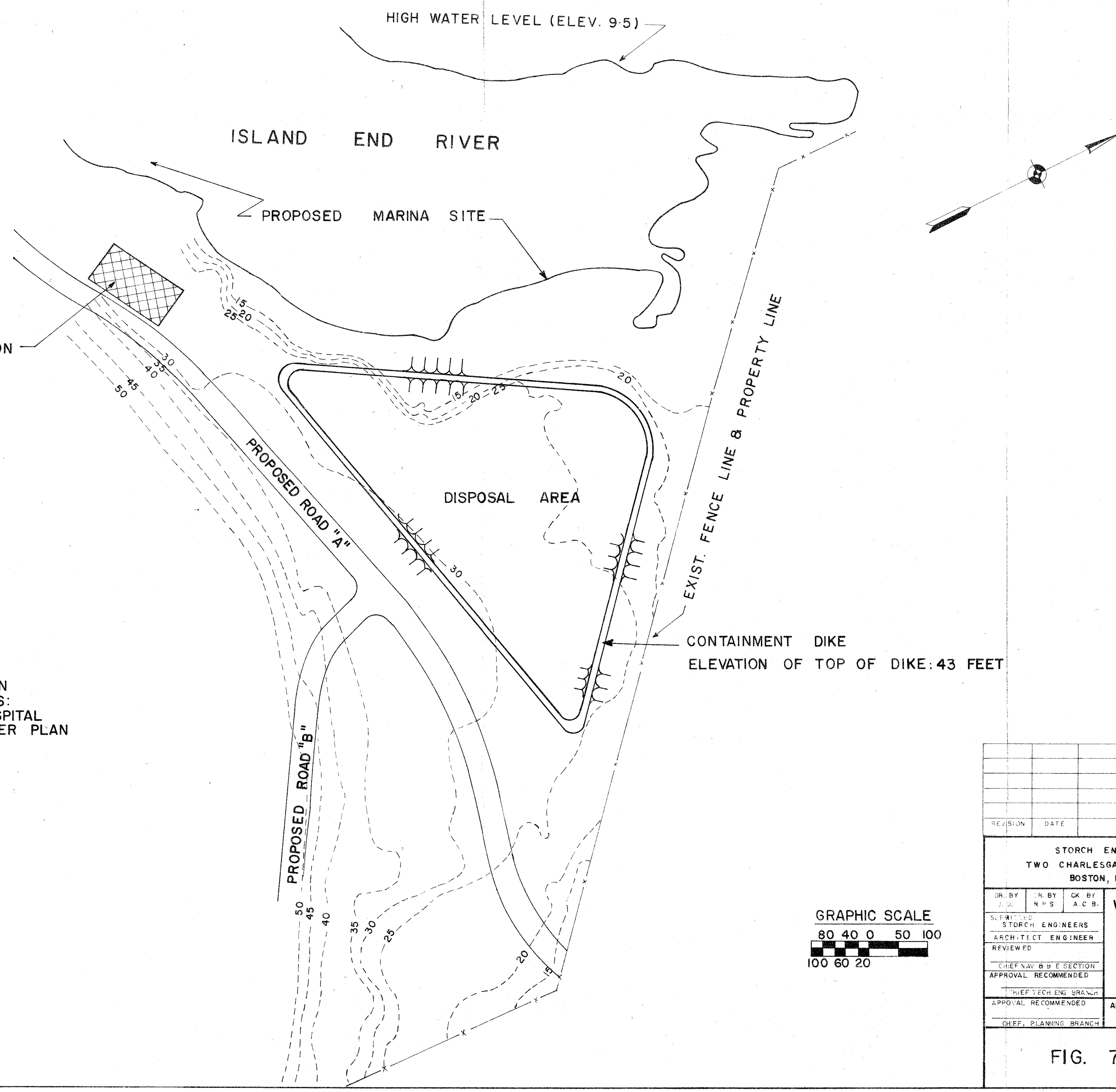
ALTERNATIVE PLAN I

APPROVED
CHIEF, ENGINEERING DIVISION
DATE

FIG. 7-4

SCALE

SPEC. NO. DACW 33-79-C-0076
DRAWING NUMBER



NOTE:

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SOURCE OF LOCATION OF PROPOSED ROADS: CHELSEA NAVAL HOSPITAL DEVELOPMENT MASTER PLAN

REVISION	DATE	DESCRIPTION	BY

STORCH ENGINEERS
TWO CHARLESGATE WEST
BOSTON, MASS.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
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SUBMITTED STORCH ENGINEERS — ARCHITECT ENGINEER

REVIEWED — CHIEF NAV. & B. E. SECTION

APPROVAL RECOMMENDED — CHIEF TECH. ENG. BRANCH

APPROVAL RECOMMENDED — CHIEF, PLANNING BRANCH

WATER RESOURCES IMPROVEMENT STUDY

ISLAND END RIVER – CHELSA, MA.

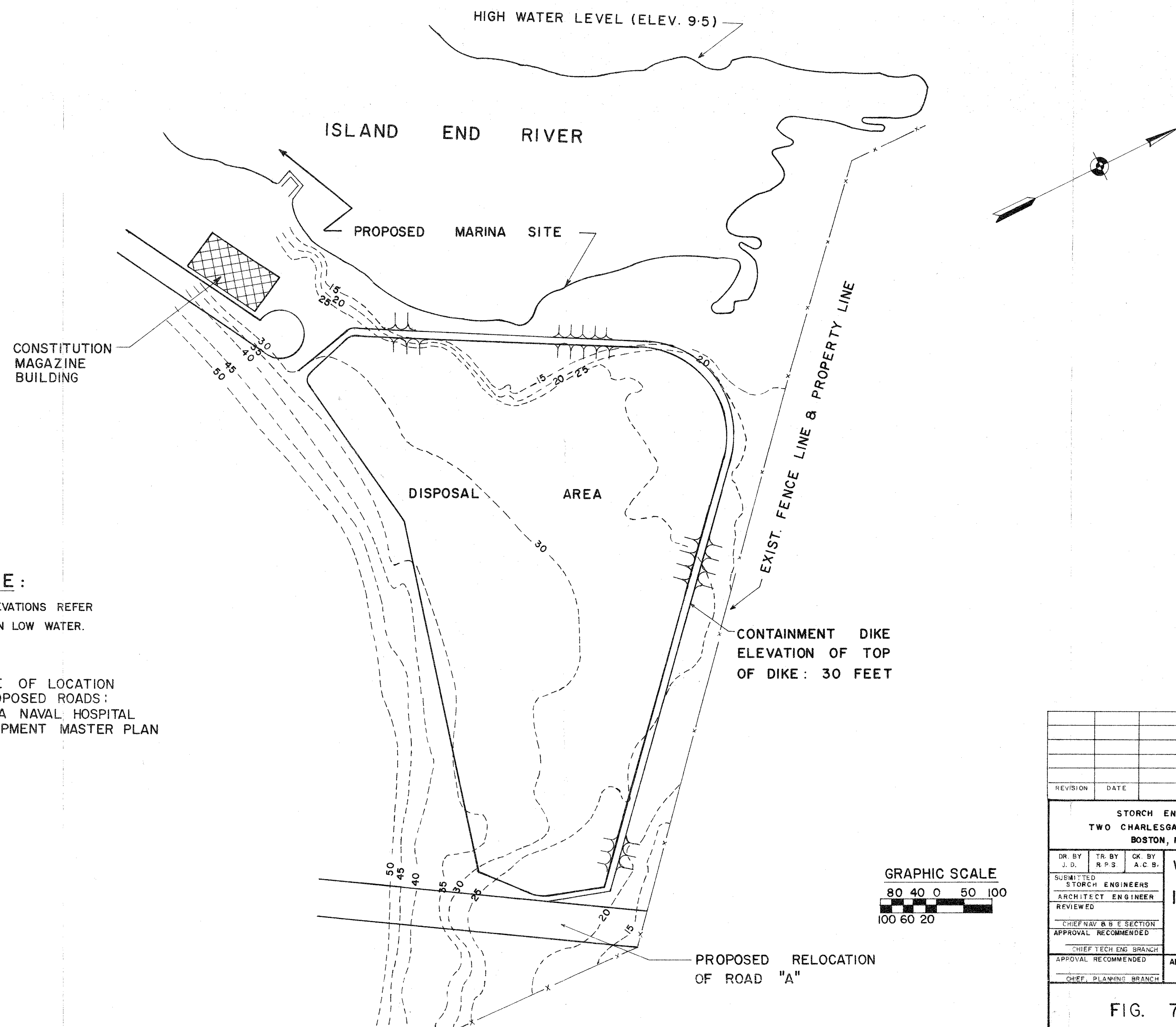
ALTERNATIVE PLAN 2

APPROVED — CHIEF, ENGINEERING DIVISION   DATE

FIG. 7-5

SCALE

SPEC. NO. DACW 33-79-C-0076
DRAWING NUMBER



NOTE:

ALL ELEVATIONS REFER TO MEAN LOW WATER.

SOURCE OF LOCATION OF PROPOSED ROADS: CHELSEA NAVAL HOSPITAL DEVELOPMENT MASTER PLAN

REVISION	DATE	DESCRIPTION	BY

STORCH ENGINEERS
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SUBMITTED STORCH ENGINEERS
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CHIEF TECH. ENG. BRANCH
APPOVAL RECOMMENDED
CHIEF, PLANNING BRANCH

WATER RESOURCES IMPROVEMENT STUDY

ISLAND END RIVER - CHELSA, MA.

ALTERNATIVE PLAN 3

APPROVED DATE
CHIEF, ENGINEERING DIVISION

FIG. 7-6

SCALE

SPEC. NO. DACW 33-79-C-0076
DRAWING NUMBER